ABSTRACTS OF NORTH AMERICAN GEOLOGY

June 1970

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

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UNITED STATES DEPARTMENT OF THE INTERIOR

WALTER J. HICKEL, *Secretary*

GEOLOGICAL SURVEY

William T. Pecora, *Director*

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ABSTRACTS OF NORTH AMERICAN GEOLOGY

INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with small circulation (such as dissertations, open-file reports of memorandums) or of other papers presented orally at meetings.

The Abstracts is an additional reference tool but does not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology are published each year. The Bibliography includes citations and subject index for a calendar year.

The numbers assigned to the abstracts in this publication are for reference in using the index; they are not order numbers. Publications cited here in abstract form are available in most geological libraries or through interlibrary loan.

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A list of journals commonly cited in Abstracts of North American Geology may be obtained by writing to the U.S. Geological Survey, Washington, D.C. 20242. Serial publications cited for the first time are as follows:

Archives Eniveronmental Health—Archives of Environmental Health. Preventive, occupational and aerospace medicine. American Medical Association. Chicago, Ill.

Canada Dept. Energy, Mines and Resources Mineral Resources Br. Mineral Inf. Bull.—Canada Department of Energy, Mines and Resources, Mineral Resources Branch Mineral Information Bulletin. Ottawa, Ontario, Canada.

Michigan Academician—Michigan Academician. Papers of the Michigan Academy of Science, Arts, and Letters. Ann Arbor, Mich.

Missouri Mineral Industry News—Missouri Mineral Industry News. Missouri Geological Survey and Water Resources. Rolla, Mo.

Soc. Paleont. Italiana Boll.—Bolletino dello Societá Paleontologica Italiana. Instituto di Paleontologia dell'Universitá Modena. Modena, Italy.

Water Research—Water Research. The journal of the International Association on Water Pollution Research. Pergamon Press. Oxford, England, and New York, N. Y.

The abstracts in this issue were prepared by Georgianna D. Conant, Howard R. Cramer, George H. Dixon, Raymond C. Douglass, S. E. Frezon, Richard E. Grant, Andrew Griscom, Anna Hietanen-Makela, John W. Huddle, Virginia M. Jussen, B. H. Kent, R. A. Loney, Elisabeth S. Loud, Mildred C. Mead, Philip B. Mudgett, Virginia S. Neuschel, A. Thomas Ovenshine, D. W. Rankin, E. G. Sable, C. L. Sainsbury, Gregg Vane, and Dorothy B. Vitaliano.

ABSTRACTS

06476 **Aaron, John M.** Petrology and origin of the Hardyston Quartzite (Lower Cambrian) in eastern Pennsylvania and western New Jersey, *in* Geology of selected areas in New Jersey and eastern Pennsylvania and guidebook . . .—Geol. Soc. America, Ann.Mtg., Atlantic City, 1969: New Brunswick, N.J., Rutgers Univ.Press, p.21-34, illus., tables, 1969.

The Hardyston Quartzite, a unit of varied lithic assemblage about 100 feet thick, at base of the Paleozoic section in eastern Pennsylvania and western New Jersey, overlies Precambrian crystalline rocks of the Reading Prong and is in transitional contact with the superjacent Leithsville Formation of Early to Middle Cambrian age. The textural fabric of the Hardyston is broadly graded: discontinuous lenses of quartz pebble conglomerate and coarse, poorly sorted arkose in lower part; better sorted, finer sandstone to silty shale in upper part. Source of detritus was local, igneous and metamorphic terrane similar to the Reading Prong. The Hardyston probably is both alluvial and marine in origin, the lower part an alluvial apron on the flank of a Precambrian shield, the upper partly reworked and augmented by orthoquartzite marine deposits of an advancing sea. — *from* Author's abstract

06872 **Abdul-Latif, Numan; Weaver, Charles E.** Kinetics of acid-dissolution of palygorskite (attapulgite) and sepiolite [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 17, no. 3, p. 169-178, illus., tables, 1969.

Palygorskite and sepiolite were digested with large excesses of hydrochloric acid at constant temperature for various periods of time. The reaction was of first order with respect to Mg, Al, and Fe components and also with respect to acid concentration. Approximately one-third of octahedral-type cations are extraneous, suggesting that only three of the five octahedral positions are filled. The reaction rate constant of Mg in sepiolite is about 240 times that for palygorskite; this may indicate that sepiolite is less stable to chemical weathering. Activation energies for Mg, Al and Fe in palygorskite are the same and equal to about 18.4 kcal per mole. Treatment of partially acid-digested palygorskite with Mg ions under alkaline conditions resulted in increase in X-ray intensity of 10.5 A spacing, suggesting some palygorskite was reconstituted. — *from* Authors' abstract

Abruscato, Joseph. *See* Hassard, John R. 06729

07017 **Achauer, C. W.; Johnson, J. Harlan.** Algal stromatolites in the James Reef Complex (Lower Cretaceous), Fairway Field, Texas: Jour. Sed. Petrology, v. 39, no. 4, p. 1466-1472, illus., 1969.

Hemispheroid algal stromatolites and related stromatolite structures are found associated with hydrozoa in the lowest biofacies. The stromatolite growth forms are discrete forms, often growing from the upper surfaces of hydrozoa, irregular forms fill spaces between hydrozoa, and some drape sides of hydrozoa. The James stromatolites grew in a subtidal environment since: (1) the hydrozoa-stromatolite zone reflects the deepest water conditions during reef core development; (2) intimate and varied growth associations between hydrozoa and stromatolites can be explained only as having developed under subtidal marine conditions; and (3) hemispheroid stromatolites and related forms are associated with in-place marine organisms in other organic reefs and banks of the geologic section. Obviously the algal stromatolites are not restricted to the intertidal environment only. — *from* Authors' abstract

Adams, John A. S. *See* Brimhall, Willis H. 06475

06592 **Adams, William Mansfield.** Prediction of tsunami inundation from current real-time seismic data: Hawaii Inst. Geophysics [Rept.] HIG-69-9, 57 p., illus., tables, 1969.

The procedure described is an elementary algorithm for obtaining an estimate of tsunami runup. The error of the estimate is very large but inspection of the components does suggest where study should be concentrated. The physics of tsunamis is discussed. The foolhardiness of any attempt to provide estimates of tsunami inundation based solely on available real-time data is indicated. Much more on-line seismic data will be required to allow meaningful estimates of tsunami inundation in real-time. Such data probably can be obtained by using satellite telemetry. More effective operation of the Warning System depends on quantitative observations of extreme water fluctuations in the source area. — ESL

06460 **Addicott, W. O.** Tertiary climatic change in the marginal northeastern Pacific Ocean: Science, v. 165, no. 3893, p. 583-586, illus., 1969.

Analysis of distributional patterns of shallow-water molluscan faunas of the middle latitudes of the marginal northeastern Pacific Ocean discloses a sharp reversal during the Miocene of the progressive climatic deterioration. A low point in the Tertiary cooling trend during the Oligocene was followed by climatic warming that culminated during the middle Miocene, as illustrated by a series of zoogeographic profiles. — Author's abstract

06598 **Agarwal, R. K.; Boshkov, S. H.** Stresses and displacements around a circular tunnel in a three-layer medium — [Pt.] 1, Use of a 'finite element' model in the analyses of stress and displacement distributions in a plate under simple loading (vertical, horizontal and midlayer): Internat. Jour. Rock Mechanics and Mining Sci., v. 6, no. 6, p. 519-528, illus., tables, 1969.

The stress and displacement fields about a circular tunnel, located in a layer of soft material and surrounded by layers of hard material, are determined for different values of the ratio of the height of soft layer to tunnel diameter using the finite element method. The results obtained are compared with available experimental data. The influence of the distribution of the stresses upon the determination of the ground stress tensor in a layered medium is discussed. — Authors' abstract

07020 **Agarwal, R. K.; Boshkov, S. H.** Stresses and displacements around a circular tunnel in a three-layer medium—[Pt.] 2, Similitude relations for a general linear nonhomogeneous model, finite element analyses of stress and displacement fields . . ., comparison of plane stress and plane strain solutions: Internat. Jour. Rock Mechanics and Mining Sci., v. 6, no. 6, p. 529-540, illus., tables, 1969.

The principle of similitude is applied to the distributions of stresses and displacements around a circular opening located in a continuous linear nonhomogeneous material. The distributions for some combined loads on a three-layer medium, obtained using the 'finite element' technique, are found to be in agreement with the postulates set forth in the similitude relationships. The stress and displacement fields under the plane stress and plane strain hypotheses are compared for two values of the ratio E_1/E_2, viz. 2 and 10. — Authors' abstract

00006 **Ahrens, Thomas J.; Takahashi, Taro; Davies, Geoffrey F.** A proposed equation of state of stishovite: Jour. Geophys. Research, v. 75, no. 2, p. 310-316, tables, 1970.

Available shock-wave data for solid α quartz in the stishovite pressure regime are reduced to a 25°C isotherm and an adiabat, centered at standard conditions, using recent standard density, enthalpy, and coefficient of thermal expansion data. The calculated isothermal bulk modulus, 3 Mb, depends critically on the value of $(dK/dP)_T$ at zero pressure and to a yet unknown extent on the form of the equation of state. The high-temperature value of Gruneisen's ratio (0.8 to 0.9) along the α quartz (stishovite regime) Hugoniot was obtained from the pressure offsets of the fused quartz and porous quartz Hugoniot. The high value for γ obtained from thermochemical data at standard conditions suggests that a marked decrease in the value of γ to 0.8 occurs with increasing temperature. — *from* Authors' abstract

Ahrens, Thomas J. *See* Gaffney, Edward S. 06815

Ahrens, Thomas J. *See* Hörz, Friedrich. 06944

06486 **Aislks, E. G.; Tarshansky, I. W.** Soil studies for seismic design of San Francisco Transbay Tube, *in* Vibration effects of earthquakes on soils and foundations — ASTM, 71st Ann. Mtg., San Francisco, 1968, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 450, p. 138-166, illus., 1969.

Tests designed to evaluate the loss of soil shear strength during an earthquake and to determine deformations and loads imposed on the tube by ground deformations are made. Seismic surveys, earthquake sensing and recording device installation, and dynamic testing of undisturbed soils are carried out. It is concluded that in these soils significant loss of strength will not occur under earthquake strains and durations. Stresses imposed on the tube by ground deformation are not of significant magnitude. — *from* Authors' abstract

Aitken, T. *See* Ewing, M. 06748

06886 **Aki, Keiiti; Reasenberg, Paul; DeFazio, Thomas; Esai, Yi-Ben.** Near-field and far-field seismic evidence for triggering of an earthquake by the BENHAM explosion: Seismol. Soc. America Bull., v. 59, no. 6, p. 2197-2207, illus., 1969.

The far-field, low-frequency seismic spectrums as well as the near-field, wide-band spectrums strongly suggest that an earthquake might have been triggered immediately after the BENHAM underground nuclear explosion. The seismic moment of the triggered earthquake is estimated from Love waves to be about 2.5×10^{24} dyne cm. This value is consistent with the length, displacement, and depth of faulting suggested by field observations and aftershock studies. The triggered earthquake appears to be associated with a low stress drop and long rise time. Inasmuch as low stress drop and long rise time are characteristic of a low efficiency, less dangerous earthquake, these results seem to encourage further exploration of the possibility that large explosions may be used for safe release of tectonic strain energy. — DBV

07011 **Albee, Arden L.; Chodos, Arthur A.** Semiquantitative electron microprobe determination of Fe^{+2}/Fe^{+3} and Mn^{+2}/Mn^{+3} in oxides and silicates and its application to petrologic problems [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 1-2, 1969.

06660 **Allan, T. D.** A review of marine geomagnetism: Earth-Sci. Rev., v. 5, no. 4, p. 217-254, illus., 1969.

The publication in 1963 of the Vine-Mathews theory of symmetrical magnetic lineations about midoceanic ridges caused a rapid reappraisal of the value of the magnetometer as a geophysical tool. A review is given of the development of marine magnetic surveys from the first reported profile made with a towed magnetometer (Heezen, et al., 1953) up to the present day. The results of magnetic surveys over continental margins and island arcs are reported, followed by a review of the earlier work over midoceanic ridges and rifts. The major part of the review traces the development of sea-floor spreading models in the Atlantic, Pacific, and Indian Oceans, the Red Sea and, finally, in the Mediterranean. — Author's summary

06379 **Am. Society Testing and Materials.** Vibration effects of earthquakes on soils and foundations — Symposium, 71st Ann. Mtg., San Francisco, 1968: Am. Soc. Testing and Materials Spec. Tech. Pub. 450, 262 p., illus., tables, 1969.

This symposium, containing nine papers, seven of which are cited separately, was sponsored by Subcommittee 9 on Dynamic Properties of Soils, of Committee D-18, of the American Society for Testing and Materials, and was designed to provide a perspective of recent research concerning earthquake and vibration effects on soils and some applications to design problems. The topics covered include the stress-strain and strength properties of soils under vibratory loading, laboratory apparatus and procedures for investigating dynamic soil behavior, studies of foundation vibrations, and design applications involving vibrations of soil-structure systems. — HRC

06548 **Amery, G. B.** Structure of Sigsbee scarp, Gulf of Mexico: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 12, p. 2480-2482, illus., 1969.

A sparker profile across the Sigsbee scarp shows an interval with an anomalously high velocity which is interpreted to be salt extruded a distance of 10 km over flat-lying beds south of the scarp. The extrusion and the topographic form of the scarp are related to basinward flow of sediments and salt from under the thick shelf-slope sedimentary wedge. — Author's abstract

06825 **Anderson, Don L.** Geophysical evidence on the petrology of the mantle [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 2, 1969.

06826 **Anderson, Franz E.** Daily, seasonal, and annual flux of suspended sediments in a northern temperate estuary [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 2-3, 1969.

06827 **Anderson, G. M.** Calculation of self-consistent curves for univariant dehydration equilibrium data [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 3, 1969.

06653 **Anderson, Henry R.; Appel, Charles A.** Geology and ground-water resources of Ocean County, New Jersey: New Jersey Div. Water Policy and Supply Spec. Rept. 29, 93 p., illus., tables, 1969.

Aquifers in Ocean County are continental, near-shore marine, beach, or deltaic deposits of porous sand and gravel; confining beds are chiefly deeper water marine deposits of clay and glauconite. The artesian aquifer systems are the Cretaceous Raritan and Magothy Formations (yields 500-1,850 gpm, soft potable water high in iron); Englishtown Formation (maximum yield 500 gpm, water levels declining); Wenonah Formation and Mt. Laurel Sand (yield less than 100 gpm, soft with high iron locally); and Kirkwood Formation (average pumpage 12 mgd, levels declining, water suitable for most uses). The water-table aquifer is pumped heavily in the Toms River and Lakehurst areas where average yield is 320 gpm, maximum 665 gpm; water has a low pH, high iron content, and an unpleasant odor. — MCM

00019 **Anderson, Jay Earl, Jr.** Recognition and time distribution of texturally altered welded tuff: Geol. Soc. America Bull., v. 81, no. 1, p. 287-291, illus., 1970.

One of the results of a lack of clearly defined welded shards in ancient silicic volcanic rocks is a lack of recognition that many of these rocks are ash-flow tuff. Ash-flow tuff units of Cambrian age in the Wichita Mountains of Oklahoma and of Precambrian age in the St. Francois Mountains of Missouri contain only a few examples of clearly defined shards. That they are, nevertheless, ash-flow tuff is shown by their widespread occurrences, broken phenocrysts, common compaction foliation, and common snowflake texture. The abundance of petrographically similar rocks in the Precambrian basement of Kansas, Oklahoma, and Texas suggests that the previously reported low relative abundance of Precambrian ash-flow resulted more from lack of recognition than from progressive crustal differentiation. — Author's abstract

06828 **Anderson, Thomas H.; Silver, Leon T.; Córdoba M., Diego A.** Mesozoic magmatic events of the northern Sonora coastal region, Mexico [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 3-4, 1969.

00034 **Andrews, J. E.** Structure and sedimentary development of the outer channel of the Great Bahama Canyon: Geol. Soc. America Bull., v. 81, no. 1, p. 217-225, illus., 1970.

The outer channel of the Great Bahama Canyon, together with the Eleuthera Ridge that forms its eastern boundary, has been formed by the flow of large-scale turbidity currents from the Great Bahama Canyon. The ridge consists of a series of levees that have migrated to the north and west to confine the channel against the base of the slope off Great Abaco Island. Deformation of the channel appears to have influenced the flow regime to the extent of creating a series of basin depressions and a major channel sill. Two large basins in the channel proper have developed in accordance

with recognized principles of hydraulic behavior for flows in channels in two-layered systems. A third basin on the face of the sill is the result of the displacement of a section of the sea floor. The outer channel of the Great Bahama Canyon demonstrates features of flow behavior that have not been observed in other fan valleys. — *from* Author's abstract

06702 **Andrieux, P.; Clark, J. F.** Application des méthodes électriques de prospection à l'étude du cratère d'Holleford [with French abs.]: Canadian Jour. Earth Sci., v. 6, no. 6, p. 1325–1337, illus., 1969.

Electrical prospecting methods have been applied to the study of Holleford crater on three different occasions. The results are discussed and compared to those from previous investigations. A certain asymmetry of the crater has been established; however, it most probably concerns the Precambrian basement rather than the impact crater itself. Supplementary measurements would be required for more precision. The depth to the undisturbed basement has been deduced to be 800 m in the center of the depression. The application of electrical methods to similar structures has been considered and evaluated. — Authors' abstract

Angino, Ernest E. *See* Watson, Jerry A. 06530

06496 **Antoine, John W.; Bryant, William R.** Distribution of salt and salt structure in Gulf of Mexico: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 12, p. 2543-2550, illus., 1969.

Recent studies indicated that it is possible for significant thicknesses of salt to be deposited in a deep-water environment. New data concerning the distribution of salt in the Gulf of Mexico basin and the assumption that the Gulf is an old basin leads to an alternate hypothesis to explain salt structure distribution in the western Gulf. Down-dip migration of salt into deeper parts of the basin as a result of overburden pressures appears to have taken place and has resulted in the known salt structures. — SEF

Antoine, John W. *See* Pyle, Thomas E. 06539

Antoine, John W. *See* Bryant, William R. 07033

Appel, Charles A. *See* Anderson, Henry R. 06653

06829 **Arem, Joel E.** Space groups and crystal structure of idocrase [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 4, 1969.

Arndt, Robert H. *See* Stroud, Raymond B. 06672

Arnold, Arthur B. *See* James, Laurence B. 06884

06883 **Association of Engineering Geologists.** 1969 field trips, National Meeting, San Francisco, Calif., 1969: [Berkeley, Calif.] Assoc. Eng. Geologists, sections paged separately, illus., tables, 1969.

This volume contains guidebooks to the six field trips held in connection with the 1969 National Meeting of the Association of Engineering Geologists in San Francisco. Appropriate maps are included. Seven papers are cited separately. — DBV

Atkinson, Sterling K., Jr. *See* McCulloch, D. S. 06987

06830 **Attaway, David H.; Parker, Patrick L.** Sterols in Recent marine sediments [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 4-5, 1969.

Avcin, Matthew J. *See* Collinson, Charles. 06765

Avcin, Susan B. *See* Collinson, Charles. 06765

06831 **Ayres, Lorne D.** Early Precambrian metasandstone from Lake Superior Park, Ontario, Canada, and implications for the origin of the Superior Province [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 5, 1969.

06901 **Babcock, Clarence.** Geology of the Upper Cretaceous clastic section, northern peninsular Florida: Florida Div. Geology Inf. Circ. 60, 44 p., illus., 1969.

The lower sediments of the Upper Cretaceous consist predominantly of sands and shales, and are present over most of southern Georgia and peninsular Florida. The sands have good porosities and would form good oil reservoirs; the shales are dark and have high organic content that could have made them sources of petroleum. Penetration by wells is insufficient to condemn the area as an oil prospect. A number of geologic cross sections and maps are presented upon which interpretations of correlations, stratigraphy, and regional structures are based. The clastic section of the Atkinson Formation is shown to pinch-out upon the underlying Lower Cretaceous, elevated along the Peninsular arch. A basal sand in the Austin interval is described and named the LaCrosse Sandstone. — *from* preface

06832 **Bachinski, Donald J.** Textural changes and sulfur isotopic composition in metamorphosed ore deposits, Notre Dame Bay, Newfoundland [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 5-6, 1969.

Bacon, Edward. *See* Galanopoulos, A. G. 06590

06833 **Baer, A. J.** Subdivision of the Precambrian southern Grenville Province in Canada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 6, 1969.

Bailey, S. W. *See* Blount, Alice M. 06988

06409 **Baines, Graham.** Potash harvest beneath the Canadian prairie: Geog. Mag., v. 41, no. 11, p. 814-818, illus., 1969.

The Prairie Evaporite is a basin of coarse crystalline salts evaporated, in hot Middle Devonian time, from a tongue of shallow water that reached from Yukon to Saskatchewan. Beds of potash, salt, and anhydrite beneath marine and glacial deposits were first discovered in 1943, in well cores brought up from depths of 2000 m in the search for oil. Estimated potash reserves are considered sufficient to supply the world, at present rate of consumption, for 800 years. In the Esterhazy mine, Saskatchewan, at 960 m, the ore is capped by rock salt which is plastic under the high pressure of 820 m of water-bearing shale and limestone, topped by 90 m of glacial till. The Blairmore formation presented notorious quicksand problems until overcome by freezing tactics with slow digging progress. First production was in 1962; there are now nine mines and an estimated production in excess of 10,000,000 tons for 1970. — GDC

06494 **Baker, Seymour R.; Friedman, Gerald M.** A non-destructive core analysis technique using X-rays: Jour. Sed. Petrology, v. 39, no. 4, p. 1371-1383, illus., 1969.

The X-radiographs obtained by this method are invaluable in determining the proper cutting orientation and sampling scheme to be used on the core. The technique utilizes an aluminum filter which, placed lengthwise over the cylindrical plastic liner of the core, effectively compensates for the difference in sediment thickness through which the X-rays penetrate. As a result of this compensation, radiographs show no change in resolution or contrast from the center to the edges of the core. This quick, easy, and inexpensive method provides a complete picture log of the core. The technique allows rotation of the core around its longitudinal axis to any desired orientation so that one can accurately record the locations and dimensions of specific particles, laminae, or structural features. — *from* Authors' abstract

06834 **Bambach, Richard.** Functional morphology and autecology of *Grammysia obliqua* (McCoy) (Bivalva) — An example of interpretive paleobiology [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 6-7, 1969.

Banerjee, Subir K. *See* Day, R. 00070

06680 **Bannister, D'Arcy; Knostman, Richard W.** Silver in the United States: U.S. Bur. Mines Inf. Circ. 8427, 34 p., illus., tables, 1969.

Productive potential of the principal silver mining districts in the United States is estimated to be 5 billion ounces of unmined silver. About 3.5 billion ounces are in deposits requiring a higher price for silver to be economically minable, and about 1.3 billion ounces are in mines currently operating. Trends of silver consumption since 1954 suggest that free-world use will be nearly 800 million ounces annually in 1985. To meet that demand, foreign hoards and production from new mines will have to supply 375 million ounces of which 20 percent, 75 million ounces, would come from mines in the United States. — PBM

06866 **Barbish, A. B.; Gardner, G. H. F.** The effect of heat on some mechanical properties of igneous rocks: Soc. Petroleum Engineers Jour., v. 9, no. 4, p. 395-402, illus., 1969.

Elastic moduli of most igneous rocks are greatly reduced by heating and depend, at room temperature, on the highest temperature to which they have been previously heated. This phenomena was investigated by measuring velocity, attenuation, bonding strength, and point penetration as functions of moisture content, pore pressure, confining pressure, and highest previous temperature for gabbro samples from French Creek, Pa. Bonding strength and point penetration tests indicate that microcracks introduced by heating up to 1000°C are uniformly distributed. Although porosity was only about one percent, the attenuation of sound waves was very dependent on moisture content, and increased greatly when pore and confining pressures were increased equally, although elastic moduli remained almost constant. Uniformity of material made exact measurement of Weibull parameters difficult. — *from* Authors' abstract

06387 **Barden, Laing; Younan, N. A.** Consolidation of layered clays [with French abs.]: Canadian Geotech. Jour., v. 6, no. 4, p. 413-429, illus., tables, 1969.

The experimental behavior of remolded layered clays undergoing both one-dimensional vertical flow and three-dimensional combined vertical and radial flow is shown to be in close agreement with exact solutions formulated in terms of Terzaghi theory. The accuracy of a number of approximate solutions for layered clays is assessed, confirming the importance of the interface flow condition. — Authors' abstract

06869 **Barnes, Charles W.; Houston, Robert S.** Basement response to the Laramide orogeny at Coad Mountain, Wyoming: Wyoming Univ. Contr. Geology, v. 8, no. 1, p. 37-41, illus., 1969.

A major problem in the controversial Laramide orogeny is understanding the mechanism whereby seemingly brittle gneisses of the Precambrian basement take almost the exact configuration of folds developed in overlying sedimentary cover, well exposed in the Medicine Bow Mts. Detailed study of Coad Mountain suggests that basement folding under relatively low load pressures might take place through passive folding along microfractures parallel to joints when the basement is once again placed in a stress field. The folding mechanism by which sedimentary veneer and basement mutually form a congruent fold surface remains a mystery. One consistent pattern is the reflection of Precambrian faults in younger fault systems; folds seem to be independent of Precambrian structures. Possibly the Laramide fold axis is perpendicular to a Precambrian lineation. — GDC

06835 **Barnes, H. L.; Scott, S. D.** Geothermometry based on iron-rich patches in sphalerite [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 7, 1969.

06972 **Barshad, Isaac; Kishk, Fawzy M.** Chemical composition of soil vermiculite clays as related to their genesis: Contr. Mineralogy and Petrology, v. 24, no. 2, p. 136-155, tables, 1969.

Analyses of the clay fractions of 11 vermiculite-bearing soils reveal two types of vermiculite clays exist: (1) an aluminous type in which the Al^{3+} substitutes for Si^{4+} in tetrahedral positions, and with Al^{3+} as the dominant octahedral ion; (2) a siliceous type in which only Si^{4+} occupies tetrahedral positions, and with Fe^{3+} and Mg^{2+} as

dominant octahedral ions. The aluminous vermiculite clay occurs in soils derived from acid igneous rocks and is usually associated with mica, whereas the siliceous type occurs in soils derived from basic igneous rocks which do not contain mica. Because of the close association with parent material, it was concluded that the aluminous vermiculite is a product of alteration of mica whereas the siliceous type is a product of synthesis from primary oxides of silica, alumina, iron, and magnesium. — *from* Authors' abstract

Bartel, A. J. *See* Rosholt, J. N. 06951

06994 **Bartlett, Charles S., Jr.; Heron, S. Duncan, Jr.; Johnson, Henry S., Jr.** Eocene age aluminum phosphates in the Carolinas: South Carolina Div. Geology Geol. Notes, v. 14, no. 1, p. 1-13, illus., 1969.

Rare wavellite and variscite were identified in the western Coastal Plain, at sites near Eocene exposures in North Carolina and at hilltop outliers in South Carolina. Beds are stratigraphically within 50 feet above Upper Cretaceous clays and sands, but lithology, sequence and proximity to fossiliferous beds place the phosphatic unit in the Black Mingo Formation of Wilcox age. Minerals occur as cement in sandstone, wavellite also as void fillings and veinlets in sandstones and residual chert. In South Carolina they are dessiminated — variscite like buckshot in clayey silt, wavellite in concretions up to 2-cm diameter in fine clayey sand. Thin sections confirm secondary origin: in North Carolina as replacements along edges of quartz grains and fillings in minute fractures; in South Carolina derived by down-moving ground water, probably from Eocene beds now eroded away. — *from* Authors' abstract

06483 **Bartlett, Grant A.** Cretaceous biostratigraphy of the Grand Banks of Newfoundland: Maritime Sediments, v. 5, no. 1, p. 4–14, illus., 1969.

Several hundred feet of Cretaceous strata underlie the Grand Banks of Newfoundland. The sediments and constituent faunas indicate the prevalence of warm, shallow waters and a basin(s) of subsidence. Periodic tectonic activity is suggested by major unconformities. These unconformities are recognizable on a worldwide scale. A salt dome of Permo-Triassic to Jurassic(?) age was active as late as Eocene time at least. Upper Jurassic and Lower Cretaceous (Neocomian) sediments contain meagre faunas. The Aptian-Albian is also poorly defined. Microfaunas are also generally sparse in the early Middle Cretaceous (Cenomanian). The Upper Cretaceous (Turonian-Maestrichtian) is characterized by abundant planktonics. The planktonic foraminifera enable a general intercontinental correlation of the Grand Banks strata. — Author's summary

06836 **Bartlett, Grant A.** Biostratigraphy and paleoecology of the Canadian Atlantic continental margin [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 7-8, 1969.

06837 **Barton, P. B., Jr.** Sulfide petrology [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 8, 1969.

06688 **Basham, P. W.** Canadian detection and discrimination thresholds for earthquakes and underground explosions in Asia: Canadian Jour. Earth Sci., v. 6, no. 6, p. 1455-1460, illus., table, 1969.

A suite of 33 Asian earthquakes and 36 Central Asia and Novaya Zemlya underground explosions are used to define the minimum detection levels in terms of surface-wave and body-wave magnitudes and the discrimination thresholds of the *M* versus *m* discriminant for the Canadian seismograph network. Under low microseismic noise conditions surface-waves can be observed for earthquakes down to *m* 4.9 and explosions down to *m* 5.9 for the region near the central Asia test sites. For events above these magnitudes, the *M* versus *m* relationships provide reliable discrimination between earthquakes and explosions. Comparison with an intracontinental study leads to the conclusion that the discrimination threshold is limited by path effects and greater distances to events about *m* 1.0 larger near the Asian test sites than near the Nevada test site. — Author's abstract

06502 **Bates, Robert C.** SMRL soil stress cell, *in* Engineering geology and soils engineering symposium, 7th Ann., Moscow, Idaho, 1969, Proc.: Boise, Idaho, Idaho Dept. Highways, p. 9-32, illus., 1969.

A 1.8-inch-diameter soil stress cell is described in detail. The construction techniques, calibration procedures, cell behavior, and uses are given. The cell's behavior in soil was evaluated by two approaches. In the first, a series of laboratory soil stress measurements were taken using the cell, and then compared to known stress distribution in the test chamber; an inclusion effect of about 8-percent over-registration was indicated. Results from finite element analysis methods, the second technique, indicate that an over-registration of 5 to 9 percent can be expected when the major stress is normal to the cell face. Over-registration is considerably higher when the major stress impinges on the edge of the cell, as it does when the cell is oriented to measure one of the minor stresses. — *from* Author's abstract

06425 **Bay, Roger R.** Hydrologinen tutkimus Yhdysvaltain pohjoisosien soilla [with English summ]: SUO, v. 20, no. 5, p. 81-85, illus., tables, 1969.

The complete water balance is being studied on several experimental peatland watersheds in the north-central United States. Data have been collected for the past seven years. About two-thirds of the annual water yield occurred in Spring before June 1, and runoff during Summer was low. Bogs did not contribute to runoff during dry periods, but low peak flows indicated some short-term storage in bogs. Additional studies, concerned with the relationships between bog water tables and the ground-water system include a geophysical study of a ground-water bog, properties of organic soils, and evapotranspiration. — *from* Author's summary

06432 **Bé, Allan W. H.; Jongebloed, Willem L.; McIntyre, Andrew.** X-ray microscopy of recent planktonic foraminifera: Jour. Paleontology, v. 43, no. 6, p. 1384-1396, illus., 1969.

Twenty-three species of living planktonic foraminifers were examined with a projection X-ray microscope, revealing their internal morphology, wall thickness and surface features without destruction of the shells. Their spatial construction and coiling pattern may be viewed from stereoscopic pairs of radiographs. Measurements of pore concentration and pore diameters were made on shell fragments. X-ray microscopy is particularly helpful in ontogenetic studies of involute species of foraminifers. — Authors' abstract

06979 **Bearce, Denny H.** Geology of the southwestern Bald Mountains in the Blue Ridge Province of Tennessee: Southeastern Geology, v. 11, no. 1, p. 21-36, illus., table, geol. map, 1969.

Two major thrust sheets, the Buffalo Mtn. and Del Rio, are composed largely of clastic sedimentary rocks of the Precambrian Ocoee Series and Lower Cambrian Chilhowee Group. Synclines in both sheets indicate post-fault folding, during which imbricate thrust faulting developed in the larger thrust sheet. The Del Rio sheet probably thins northeastward by wedging out; possibly only the lower, most deformed portion, nearest the sole fault remains, the upper portion having been bevelled by the over-riding Buffalo Mtn. sheet. Increased deformation in the thinned southwest end of the Buffalo Mtn. sheet and greater deformation in the northeastern-most exposure of the Del Rio suggests that the latter sheet reflects the structure of the Buffalo Mtn. sheet at depth. Late stage folding of the Buffalo Mtn. thrust, perpendicular to the direction of movement, formed a continuous synclinal trend. — *from* Author's abstract

00061 **Beaty, Chester B.** Age and estimated rate of accumulation of an alluvial fan, White Mountains, California, U.S.A.: Am. Jour. Sci., v. 268, no. 1, p. 50-77, illus., tables, 1970.

The Milner Creek fan, on the west side of the range, overlies the Bishop Tuff, dated by K-Ar as 700,000 years old. The *average* rate of accumulation of the fan is 3200 cubic yards per year, or sedimentation of 3 to 6 inches per thousand years. The fan is believed to consist mainly of debris-flow material and must have grown spasmodi-

cally, gaining volume with each flow. The fan is in a stage of active growth, "youthful" in the Davisian sense. This is in conflict with other theories of fan formation in the area. Probably contrasting conditions of growth, dynamic equilibrium, or dissection could prevail simultaneously in the White Mountains region and perhaps a more general theory of fan origin, not yet satisfactorily devised, would encompass all of the observed and reported conditions. — *from* Author's abstract

06971 **Beck, Lawrence D.** Petrologic investigation of the plutonic and related rocks of Comanche Peak area, Colorado: Mtn. Geologist, v. 6, no. 4, p. 199-220, illus., tables, 1969.

Two phases of sillimanite-bearing granitic rocks have intruded nearly vertically dipping metasediments as part of a large stock-like pluton. The writer feels that the granitic rocks are genetically related to the surrounding biotite gneiss. Until more thorough investigations are finished, the following sequence of events seems compatible with observations and experimental studies. A layered sequence, including graywackes, arenites, argillites, and some basalts, was subjected to several Precambrian metamorphic events affecting the northern Front Range, the latest major event producing the biotite gneiss. The high-grade mineral assemblages of the entire area, and the specific mineralogy of the gneiss suggest that the granitic magma was produced by partial melting of the biotite gneiss in the deeper zones during this same major event. — *from* Author's abstract

06838 **Beeson, M. H.; Jackson, E. D.** Chemical and mineralogical trends during fractional melting of the mantle beneath Oahu [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 8-9, 1969.

06451 **Beeson, Melvin H.; Jackson, Everett D.** Chemical composition of altered chromites from the Stillwater Complex, Montana: Am. Mineralogist, v. 54, nos. 7-8, p. 1084-1100, illus., tables, 1969.

Small amounts of very iron-rich chromite are formed as an alteration product of normal cumulus chromite accompanying the alteration of primary silicates to chlorite in the Stillwater Complex, Montana. We have analyzed two parent chromite-ferritchromit pairs from the Stillwater Complex by a combination of wet and microprobe methods; both the parent chromite and ferritchromit can be expressed by general formula $(Mg, Fe^{2+})(Cr, Al, Fe^{3+})_2O_4$, and neither contains cation deficiencies of the maghemite type. The alteration is essentially a volume-for-volume replacement of MgO and Al_2O_3 by FeO and Fe_2O_3; content is only slightly different in the primary and secondary phases. — Authors' abstract

06898 **Beffort, J. D.** Ground-water investigation for the city of Gettysburg, South Dakota: South Dakota Geol. Survey Spec. Rept. 44, 48 p., illus., table, 1969.

Present water supply is from two deep wells within the City of Gettysburg; although supply is sufficient, quality is inferior. Glacial deposits contain no continuous bed of sufficient thickness and permeability to produce long term, high capacity yields to wells. Sandstones of the Dakota Formation and Fall River Sandstone are the only bedrock formations known to yield sufficient water for city needs; the Dakota occurs approximately 1,800 feet below land surface with waters under artesian pressure, the Fall River about 2,200 feet below produces flowing wells. The two best localities for shallow ground-water supply delineated by this survey are at some distance from the city, but quality of water is generally good. Further testing and drilling will be required to compare costs of alternate development projects. — MCM

06899 **Beffort, J. D.** Ground-water investigation for the city of Lennox, South Dakota: South Dakota Geol. Survey Spec. Rept. 46, 44 p., illus., tables, 1969.

From data collected during a survey of the Lennox area to find a water source of better quality and in larger quantities, it was found that surface outwash exists adjacent to Long Creek, in an area southwest of Lennox, and in the Vermillion River valley; a basal gravel is present directly upon bedrock over most of the area; and sandstones of the Dakota Formation constitute an aquifer in the city and to the south

and east. On the basis of water-quality data also, it is recommended that further test drilling, installation of observation wells, test pumping, and water analyses be made on aquifers in glacial deposits. Should they be inadequate for supplies, the Dakota Sandstone should be explored. — MCM

06839 **Behre, Charles H., Jr.** Necessary curricula for careers in applied geology [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 9-10, 1969.

06840 **Behrens, E. W.; Frishman, S. A.; Sever, J.** Preservation of organic components of a recent blue-green algal mat sequence [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 10, 1969.

Behrens, E. William. *See* Frishman, Steven A. 06811

06492 **Bell, J. R.; Clarke, J. D.; Johnson, E. L.** Lessons from an embankment failure analysis utilizing vane shear strength data, *in* Engineering geology and soils engineering symposium, 7th Ann., Moscow, Idaho, 1969, Proc.: Boise, Idaho, Idaho Dept. Highways, p. 199-210, illus., 1969.

Review and analysis of the failure of a 350-ft section of an embankment on the Coos Bay-Roseburg highway in Oregon leads to the conclusions that (1) the vane shear device will not adequately indicate the degree of sensitivity of soft soils and does not provide much information on their stress-strain relationships; a few exploratory borings and physical samples are needed when the device is used. (2) Field observations and measurements may lose their value and significance unless presented and studied in a form consistent with the relevant theory. (3) When dealing with soils, theories and procedures must never be applied without first evaluating the degree to which the basic assumptions of the theory describe the real conditions being analyzed. — DBV

06841 **Belt, Edward S.** Mary Creek reef complex, St. John, U.S. Virgin Islands — A model for reef facies [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 10-11, 1969.

06842 **Benedict, L. G.; Thompson, R. R.** Subdivision of vitrinitic macerals [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 11, 1969.

Bennett, J. M. *See* Moore, P. B. 06676

Bennin, Robert. *See* Brier, Chester. 06520

06843 **Benson, William E.** Lithology and mineralogy of cores from western Atlantic, Leg 4, Deep Sea Drilling Project [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 11-12, 1969.

06431 **Berger, Wolfgang H.** Planktonic foraminifera — Basic morphology and ecologic implications: Jour. Paleontology, v. 43, no. 6, p. 1369-1383, illus., table, 1969.

Three basic variables suffice for building geometric models of planispirally coiled foraminifera with spherical chambers. They are (1) the ratio between successive chamber radii, (2) the angle between the lines connecting the center of the test with two successive chamber midpoints, and (3) the amount of overlap between successive chambers. Of these, the chamber ratio is shown to be the most important for growth relationships between diameter, surface, volume and wall thickness. This variable is easily measured and has important implications for paleoecology. It appears to be applicable to all planktonic foraminifera, even those with nonspherical chambers. — Author's abstract

06844 **Berggren, W. A.** Cenozoic biostratigraphy, planktonic foraminiferal zonation and the radiometric time-scale [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 12, 1969.

Berkshire, D. C. *See* McLaughlin, W. A. 06511

Bermingham, John J. *See* Bretsky, Peter W. 06851

00039 **Berner, Robert A.** Sedimentary pyrite formation: Am. Jour. Sci., v. 268, no. 1, p. 1-23, illus., tables, 1970.

Pyrite can be synthesized at neutral pH in concentrated sulfide solution and in natural sediments by the reaction of precipitated FeS with elemental sulfur at 65°C. Similar reactions at sedimentary temperatures should require several years. The major steps in sedimentary pyrite formation are: bacterial sulfate reduction, reaction of H_2S with iron minerals to form iron monosulfides, and the reaction of iron nonsulfides with S to form pyrite. In sediments from the coastal region of central Connecticut, the main factor limiting pyrite formation is the availability of metabolizable organic material. The Fe and sulfate are present in excess and essentially all the FeS is transformed by elemental sulfur to pyrite. In lower iron sediments, especially carbonates, the principal limiting factor is more likely to be the concentration of reactive iron. In most sediments total iron content and diffusion of sulfate are not limiting. — *from* Author's abstract

06845 **Berry, William B. N.** Some aspects of monograptid graptolite evolution [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 12-13, 1969.

06846 **Berry, William B. N.; Takagi, Robert S.** Electron microscope study of *Orthograptus quadrimucronatus* from the Maquoketa Formation (Late Ordovician) in Iowa [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 13, 1969.

Biehler, Shawn. *See* Folinsbee, R. Allin. 06807

00054 **Bigham, Robert E.; LoPinto, Victor J.** Performance of embankments constructed over peat — Discussion [of paper 6333, by W. G. Weber, Jr., 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM 1, p. 309-310, 1970.

Weber (ibid., v. 95, no. SM 1, p. 53-76, 1969) attributes the increased stability of fills having sand drains to pile action of the drains. It seems to Bigham that large fill settlements in sand drain areas, good agreement of estimated and actual settlements, and increased strength of peat after construction indicate that fills were carried by peat rather than sand drains; peat is compressed to slightly less than half its original thickness. LoPinto suggests that Weber's conclusion 4 be expanded by adding, "Rates of long-term settlements may also be reduced by controlled vibratory compaction over sand blankets and fills." Rapid settlement of peat upon load application can be considered the only significant one. — ESL

Bigler, Gaston. *See* Londe, Pierre. 00044

06459 **Billy, Cécile; Cailleux, André.** Dendrites de manganèse et bactéries: Sci. Progrès Découverte, no. 3414, p. 381–385, illus., 1969.

Dendrites of manganic and ferric oxides, common on plane surfaces and natural fractures of many different minerals and rocks, are shown to be of bacterial origin. *Bacillus cereus*, widespread in nature, was isolated in the laboratory from samples of limestone bearing dendrites. This bacterium formed sporulating colonies on an agar medium to which salts of manganese (e.g. carbonate) or iron (e.g. citrate) has been added; the colonies had the chemical composition and appearance of natural dendrites. Dendrites were also formed on a sterile fragment of limestone placed in a liquid medium containing manganese carbonate and inoculated with the bacterium. Natural dendrites possibly can be used as paleoclimatic indicators as those formed in present cold climates differ somewhat in appearance from those in tropical climates. — VMJ

Bird, Derwood B. *See* Fournier, Robert O. 06808

06656 **Bjorklund, L. J.** Reconnaissance of the ground-water resources of the upper Fremont River valley, Wayne County, Utah: Utah Dept. Nat. Resources Tech. Pub. 22, 54 p., illus., tables, 1969.

The upper Fremont River valley, a depression caused by faulting, altered by erosion, and partly filled by alluvium eroded from surrounding highlands, includes about 40 sq mi in south-central Utah. Triassic, Jurassic, Tertiary, and Quaternary sedimentary rocks and Tertiary volcanic rocks are exposed; the latter yield water to several large springs and flowing wells and are the principal sources of ground water in the valley. Quaternary valley fill, more than 500 feet thick in places, is also an important source. A large but undetermined quantity of water is stored under both artesian and water-table conditions in volcanic rocks bordering and underlying the valley. Irrigation is the principal use of both surface and ground water. Ground water is suitable for most uses. — *from* Author's abstract

00001 **Blackadar, R. G.** (editor and compiler). Report of activities — Pt. A, April to October, 1969: Canada Geol. Survey Paper 70-1, pt. A, 251 p., illus., tables, 1970.

This report, containing 143 short papers, many illustrated by page-size maps and figures, presents preliminary results of field work undertaken by members of the Geological Survey of Canada in 1968 in the fields of: Appalachian geology, coal research, continental margins, Cordilleran geology, engineering geology, geochemistry, geomathematics, geophysics, mineral deposits, paleontology and biostratigraphy, petrology, Precambrian geology, Quaternary geochronology and paleontology, Quaternary geology (inventory mapping and stratigraphic studies), Quaternary sedimentology and geomorphology, stratigraphy, and general (study of continental drift, and mineral collecting in Canada). — Author's abstract

Blanc, Daniel. *See* Guedelia, Daniel. 00072

00024 **Blatt, Harvey.** Determination of mean sediment thickness in the crust — A sedimentologic method: Geol. Soc. America Bull., v. 81, no. 1, p. 255-262, illus., tables, 1970.

Mean sediment thickness, volume of detrital quartz, and grain size distribution of detrital quartz for the total sediment mass of the Earth's crust have been calculated using sedimentologic and petrologic data. Mean sediment thickness is 2690 feet and represents erosion of 7640 feet of crystalline rocks. The percent of detrital quartz in the sediment mass is estimated to be 21.0 percent. The detrital quartz has a mean grain size of 4.0ϕ; its frequency distribution is lognormal with standard deviation of 2.5ϕ. The mean size of quartz from newly disintegrated crystalline rocks is 0.67 mm, thus the mean size of 0.06 mm determined for the Earth's detrital quartz represents a size decrease of 90 percent by sedimentary processes. — *from* Author's abstract

06648 **Blench, T.** Mobile-bed fluviology — A regime theory treatment of canals and rivers for engineers and hydrologists: Edmonton, Alberta, Canada, Univ. Alberta Press, 165 p., illus., tables, 1969.

This text, for a two-semester course on quantitative fluviology (entitled River Engineering at the University of Alberta) can be adapted for majors in several fields and used also for an undergraduate hydrology course. Material has been adapted from earlier texts and other writings (Blench, 1951, 1957, 1961, 1964). Chapter headings are: introductory; river types and problems; system in river parameters; initial terminology and concepts; importance of Indo-Gangetic canals; nature and history of formal regime theory; basic, auxiliary and derived equations for sand-bed canals in regime; formula applications — canals of small bed-load charge of sand, discharge effectively steady, fluctuating canal flow with moderate bed-load charge of sand; desiderata before applying formulas to rivers; applications of regime formulas to rivers; river models; sediment exclusion and ejection; philosophy. Illustrations and diagrams are appended. — MCM

06988 **Blount, Alice M.; Threadgold, I. M.; Bailey, S. W.** Refinement of the crystal structure of nacrite [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 17, no. 3, p. 185-194, illus., tables, 1969.

The crystal structure of nacrite from Pike's Peak, Colo., has been refined by least squares and electron density difference maps utilizing 10 levels of data. Ideal structure is based on a 6R stacking sequence of kaolin layers, in which each layer is shifted

relative to the one below. The pattern of vacant octahedral sites reduces symmetry to *Cc* and permits description of the structure as a 2-layer form with an inclined Z axis. Nacrite has a greater interlayer separation and smaller lateral dimensions than dickite and kaolinite, and the observed β angle deviates by 1.5° from the ideal value. These features, as well as its overall lesser stability, are believed due to less favorable positioning of the basal oxygens relative to directed interlayer hydrogen bonds. — *from* Authors' abstract

06894 **Blume, John A.** Response of highrise buildings to ground motion from underground nuclear detonations: Seismol. Soc. America Bull., v. 59, no. 6, p. 2343-2370, illus., tables, 1969.

Typical data obtained thus far on the response of highrise Las Vegas buildings to ground motion from distant nuclear events are presented, together with measured response to distant earthquakes and wind gusts. It is shown that highrise Las Vegas buildings respond to ground motion with considerable amplification, that the fundamental modes tend to dominate the peak responses although there are exceptions, that there can be significant modification of loading conditions because of simultaneous motion in the two horizontal axes even though a building is symmetric, and that some building periods vary with amplitude history of non-damaging prior response while others do not. In general there are indications that code earthquake design criteria are by no means conservative. — DBV

06385 **Bockheim, James G.; Schlicte, A. Kenneth; Crecelius, Erich A.; Kummer, John T.; Pongsapich, Wasant; Tenbrink, Norman W.; Weber, William M.; Gresens, Randall L.** Compositional variations of the Mazama ash as related to variation in the weathering environment: Northwest Sci., v. 43, no. 4, p. 162-173, illus., tables, 1969.

Samples of Mazama volcanic ash were collected from B or C horizons at 10 localities in central Washington, representing a range of 15 to 115 inches of annual precipitation. Definitive trends of compositional variation are related to present differences in annual precipitation, assuming the original composition of the ash was reasonably uniform. With increasing precipitation, Fe, Al, and Ti, which form insoluble hydroxides, show marked relative increase; Na and K, which form soluble cations, show marked relative decrease (Ca shows lesser decrease); Mg, which may form either, decreases slightly. Percent change is calculated between conditions of 20 and 100 inches of annual precipitation over 6,600 years of weathering, assuming that the Al content remains unchanged; for oxides of K, Na, Ti, and Fe, respective percentages are -49, -46, -11, and +8. — VMJ

Bodvarsson, G. *See* Emilia, D. A. 06962

Boettner, Edward A. *See* Weiss, Benjamin. 00011

Bolt, Bruce A. *See* Nuttli, Otto W. 06570

Bond, Gerard C. *See* Manheim, Frank T. 00059

Bondesen, Erling. *See* Sörensen, Henning. 07026

06847 **Bonilla, M. G.** Some engineering geology aspects of surface faulting and related tectonic movements [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 15, 1969.

Bonilla, M. G. *See* McCulloch, D. S. 06987

06571 **Boore, David M.** Effect of higher mode contamination on measured Love wave phase velocities: Jour. Geophys. Research, v. 74, no. 27, p. 6612-6616, illus., tables, 1969.

In some circumstances the first higher mode of the Love surface wave can be significantly excited in the period range 30-90 sec by earthquakes and may travel at a group velocity comparable to that of the fundamental mode. This difficult-to-separate con-

tamination will produce a large scatter, but no uniform bias, in phase velocities measured from an ensemble of events. The phase velocities measured from a single event may show a bias over a limited range of periods, but this perturbation may be positive or negative. These results argue against an explanation of observed inconsistencies of Love and Rayleigh wave phase velocities as being due to higher mode contamination. The results are also applicable to the effect of multipath interference of two similar-mode waves traveling at an angle with respect to one another. — Author's abstract

Boorman, R. S. *See* Sutherland, J. K. 06446

Boothroyd, Jon C. *See* Hayes, Miles O. 06733

Borcherdt, R. D. *See* McCulloch, D. S. 06987

06958 **Borg, I. Y.** Erratum — Optical properties and cell parameters in the glaucophane-riebeckite series (1967): Contr. Mineralogy and Petrology, v. 24, no. 1, p. 92, 1969.

Errors to original paper (ibid., v. 15, no. 1, p. 67-92, 1967) and those not in the first erratum (ibid., v. 17, no. 1, p. 84, 1968) are listed: footnote to table 4 (symbols are for vibration directions nearest to the *c*, *b*, and *a* axes), in table 5 (number of formula units of Mg should be 2.075), and in figure 3 (uppermost unit on right hand ordinate for *n* should be 1.720). — MCM

Borgman, G. N. *See* McCulloch, D. S. 06987

06554 **Borns, Harold W., Jr.; Goldthwait, Richard P.** Late-Pleistocene fluctuations of Kaskawulsh Glacier, *in* Icefield Ranges Research Project scientific results, V. 1 (V. C. Bushnell and R. H. Ragle, editors): New York, Am.Geog.Soc., and Montreal, Quebec, Arctic Inst.North America, p. 187-196, illus., tables, reprinted 1969; originally published 1966.

This paper was published originally in Am. Jour. Sci., v. 264, no. 8, p. 600-619, 1966; *see* Abstracts of North American Geology, August 1967. — MCM

Borns, Harold W., Jr. *See* Stuiver, Minze. 06701

07018 **Borst, Roger L.; Gregg, Robert Q.** Authigenic mineral growths as revealed by the scanning electron microscope: Jour. Sed. Petrology, v. 39, no. 4, p. 1596-1597, illus., 1969.

The paragenetic sequence of three authigenic minerals has been photographed in a fine-grained sandstone using the scanning electron microscope (SEM). The instrument used in these studies is the Stereoscan, manufactured by the Cambridge Instrument Company. The SEM is superior to the transmission electron microscope for revealing delicate authigenic minerals. The electron micrographs illustrate the value of the SEM in studying microfeatures of sedimentary rocks and point out the continuing need for supplementary mineralogical data. — Authors' abstract

Boshkov, S. H. *See* Agarwal, R. K. 06598

Boshkov, S. H. *See* Agarwal, R. K. 07020

Bostrom, R. C. *See* Sherif, M. A. 06661

Bottino, Michael L. *See* Fullagar, Paul D. 06813

06567 **Boucher, Gary; Fitch, Thomas J.** Microearthquake seismicity of the Denali fault: Jour. Geophys. Research, v. 74, no. 27, p. 6638-6648, illus., table, 1969.

Microseismicity of the Denali fault was sampled by high-gain portable seismographs at 22 sites between Mt. McKinley National Park and Haines, Alaska, during July and August of 1967. The rates of very local microearthquake activity varied from 0 to about 40 events per day, which was unexpected because of the lack of recent major

earthquake activity. Hence, a new fault is suggested in the Dezadeash Lake region of the Denali fault zone, based on geological and topographic evidence. The new fault provides a mechanically more acceptable trend for large transcurrent displacements by straightening the Denali fault zone near the junction of the Shakwak Valley and the Haines fault segments. — GV

06911 **Boucot, Arthur J.; Johnson, J. G.; Talent, John A.** Early Devonian brachiopod zoogeography: Geol. Soc. America Spec. Paper 119, 106 p., illus., table, 1969.

Generically cosmopolitan Silurian brachiopod faunas gave way in Gedinnian (earliest Devonian) time to two discrete faunal provinces: the Appalachian, comprising eastern North America, and the Old World, including Australia and western North America. In the late Gedinnian and Siegenian, subprovinces were defined within the Old World Province. Provinciality reached a maximum in early Emsian time, when both provinces were subdivided and the Malvinokaffric Province was defined in the Southern Hemisphere. By late Emsian and Eifelian, only the undifferentiated Appalachian and Old World provinces were definable. About 100 diagnostic brachiopod genera are figured; localities of these elements and provincial boundaries are plotted on four maps of successive stages. A correlation chart of Lower Devonian rocks is appended. — VMJ

Boulogne, A. R. *See* Keys, W. Scott. 06595

06848 **Bowes, D. R.; Skinner, W. R.** Petrochemical variations in the Stillwater Complex, Montana [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 15-16, 1969.

Bowin, Carl O. *See* Folinsbee, R. Allin. 06807

06522 **Bowles, Frederick A.; Bryant, William R.; Wallin, Charles.** Microstructure of unconsolidated and consolidated marine sediments: Jour. Sed. Petrology, v. 39, no. 4, p. 1546-1551, illus., table, 1969.

Sediment samples from cores taken in the Gulf of Mexico were subjected to normal laterally confined loads of 0.5, 4.0, 32.0, and 64.0 kg per cm^2. Electron micrographs of their microstructure show the progressive change in particle orientation during the laboratory consolidation of a sediment sample. A predominantly random arrangement of particles exists over the greater portion of the void ratio range. Strongly preferred orientation apparently develops at pressures in excess of a few kg per cm^2. — Authors' abstract

06540 **Bowles, R. C.** Ira A. Brinkerhoff (1904-1969): Am. Assoc. Petroleum Geologists Bull., v. 53, no. 12, p. 2559, portrait, 1969.

Bowser, Carl J. *See* Nriagu, Jerome O. 06670

Boyce, R. E. *See* Heezen, B. C. 06736

06849 **Boyd, F. R.** Garnet lherzolites and the system $CaSiO_3$-$MgSiO_3$-Al_2O_3 [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 17-18, 1969.

06935 **Brace, W. F.** Laboratory studies pertaining to earthquakes: New York Acad. Sci. Trans., ser. 2, v. 31, no. 7, p. 892-906, illus., 1969.

Several laboratories are currently experimenting with the mechanics of earthquakes, particularly of the shallow focus type common in western United States. By investigating fractured and intact rock at pressures corresponding to depths of up to 25 km or more, features noted in recent seismological studies in California have been duplicated in considerable detail. Frictional sliding, sensitive to differences in mineralogy, may be jerky (stick-slip) or smooth creeping; laboratory earthquakes have been produced by raising pore pressure in rock under stress. Objectives of current studies are: possible mechanical instabilities; changes in rock properties as stress is increased to the point of instability; and possibility of converting stick-slip motion to stable sliding in a given fault system. Results are summarized. — GDC

00035 **Bradley, William C.** Effect of weathering on abrasion of granitic gravel, Colorado River (Texas): Geol. Soc. America Bull., v. 81, no. 1, p. 61-80, illus., 1970.

Granitic pebbles in alluvium in the 160 miles between Austin, Texas, and the Columbus-Eagle Lake area diminish in size by about 50 percent and change from a predominantly granite-gneiss-aplite assemblage upstream to a pegmatite-graphic granite assemblage downstream. Fresh and weathered specimens of these lithologies were experimentally abraded in a Kuenen-type tank. After 160 miles of experimental travel, fresh pebbles showed a 10 percent reduction in size; weathered pebbles showed reduction of more than 50 percent. The degree of abrasion was related to lithology; biotite-bearing granite, gneiss and some aplite were least durable; biotite-free pegmatite and graphic granite were most durable. These data suggest that weathering and abrasion, and not selective sorting, cause the downstream changes observed in granitic pebbles in the Colorado River alluvium. — ATO

Bradley, William C. *See* Fahnestock, Robert K. 06820

06950 **Brady, B. T.** The effect of mechanical anisotropy on the transmission of low-amplitude stress waves in brittle rock: Internat. Jour. Rock Mechanics and Mining Sci., v. 6, no. 5, p. 439-452, illus., table, 1969.

Results are presented of a study of transmission of low-amplitude stress waves in dry brittle rocks which are characterized by a mechanical anisotropy resulting from non-random distribution of open cracks within the rock structures. It is assumed that the dynamic response of brittle rock is dependent only on intrinsic (crack-free) properties and density and distribution of open cracks within the rock structure. It is shown that, irrespective of direction of wave transmission, dynamic stress-strain relations display a symmetry characteristic of materials exhibiting orthotropic anisotropy. Equations relating bar and free medium velocities to orthotropic 'elastic' constants are discussed; a combination of the two methods can be used to completely specify dynamic elastic constants for a single oriented specimen of rock. — *from* Author's abstract

07001 **Brecher, Henry H.** Surface velocity measurements on the Kaskawulsh Glacier, *in* Icefield Ranges Research Project scientific results, V. 1 (V. C. Bushnell and R. H. Ragle, editors): New York, Am. Geog. Soc., and Montreal, Quebec, Arctic Inst. North America, p. 127-143, illus., tables, revised 1969; originally published 1966.

Positions of 24 markers on the upper north arm of the Kaskawulsh Glacier were determined by intersection or resection on five occasions between July 12 and August 14, 1964. Surface velocities over four time periods of several days and two two-week periods were computed from the position determinations and compared to mean seasonal velocities. It was found that differences from mean seasonal values are randomly distributed. Annual velocities of three markers along the glacier centerline appear to be very slightly greater than summer velocities. An analysis of the errors in the results indicates that the errors in velocity differences are generally about as large as the apparent differences. It is concluded that there are no significant differences from mean seasonal velocities over the short time intervals. [Originally published as Ohio State Univ. Inst. Polar Studies Rept. 21, 1966.] — Author's abstract

06850 **Breimer, Albert; Macurda, Donald B., Jr.** The phylogeny of the fissiculate blastoids [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 18, 1969.

Brekke, Tor L. *See* Goodman, Richard E. 00056

06851 **Bretsky, Peter W.; Bermingham, John J.** Paleoecology of Ordovician scaphopods in eastern Iowa [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 19, 1969.

06852 **Bretsky, Sara S.** Disparity between phenetic and phylogenetic classifications at supraspecific levels [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 19-20, 1969.

06515 **Brezina, Jiri.** Granulometer — A sediment analyzer directly writing grain size distribution curves: Jour. Sed. Petrology, v. 39, no. 4, p. 1627-1631, illus., 1969.

The Woods Hole Rapid Sediment Analyzer for sands is modified to be more rapid. Its modification, called a granulometer, can plot grain size distribution curves from 100 to 250 sand samples a day, that is 2500 to 6500 monthly or 30,000 to 75,000 a year. Sedimentation methods, owing to their technical improvements, represent a positive alternative to sieving for grain size analysis. They can offer a good source of data to be treated statistically by computer. — Author's abstract

06591 **Brice, James C.; Levin, Harold L.** Laboratory studies in Earth history: Dubuque, Iowa, Wm. C. Brown Co., Publishers, 202 p., illus., revised 1969; originally published 1960.

The main purpose of this revised edition is to interest the general student in historical significance and interpretation of rock outcrops and to provide information and experience for independent work for laboratory and home assignments. Among items needed are a microscope and the 1965 edition of the *Geologic map of North America*. Sections are titled: natural history of sand, sedimentary rocks under microscope and in hand specimen, inferences from outcrops, time sequence of events, inferences from geologic maps, fossils and their living relatives, geologic provinces, Precambrian geology, continental submergence (the North American craton, folded strata (Arbuckle Mts.), stratigraphic scenery (Colorado Plateau), crustal movement (San Francisco Bay). Appended are a section on metamorphic rocks and a reference list of handbooks, guidebooks and maps. — MCM

06455 **Bricker, Owen P.** Stability constants and Gibbs free energies of formation of magadiite and kenyaite: Am. Mineralogist, v. 54, nos. 7-8, p. 1026-1033, illus., 1969.

Thermodynamic data for magadiite and kenyaite determined from solubility measurements at 25°C indicate that these minerals are stable in alkaline waters rich in sodium and silica. Waters with these characteristics are reasonably common in nature, ranging from alkaline bicarbonate-carbonate lakes and springs on one hand to sodium chloride rich brines, springs and interstitial marine and continental waters on the other. The sodium silicate minerals provide a mechanism for moderating dissolved silica, sodium ion and pH in such environments. Magadiite has been reported from four localities including Alkali Lake, Oregon, and Trinity County, California, where it is associated with either sodium bicarbonate or sodium chloride waters. Kenyaite has thus far been observed only as an alteration product of magadiite in the High Magadi Beds in Kenya. — Author's abstract

06520 **Brier, Chester; Bennin, Robert; Rona, Peter A.** Preliminary evaluation of a core scintillation counter for bulk density measurement in marine sediment cores: Jour. Sed. Petrology, v. 39, no. 4, p. 1509-1519, illus., tables, 1969.

A core scintillation counter which measures transmitted gamma radiation was applied to determine wet bulk density of cores of marine sediment sealed in plastic liners. A preliminary evaluation indicates that two principal problems affecting accuracy of bulk density determinations are: (1) the radioactive source emits random radiations, which must be treated statistically to determine the dependence of counting accuracy on number of counts, and (2) the Compton mass attenuation coefficient, which must be known in order to calculate density from scintillation counts, varies significantly with sediment composition and water content. — Authors' abstract

06739 **Briggs, Darinka Z.; Briggs, Louis I.** A system of information analysis for geological documents [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 20, 1969.

Briggs, Louis I. *See* Briggs, Darinka Z. 06739

06475 **Brimhall, Willis H.; Adams, John A. S.** Concentration changes of thorium, uranium and other metals in hydrothermally altered Conway Granite, New Hampshire: Geochim. et Cosmochim. Acta, v. 33, no. 10, p. 1308-1311, illus., 1969.

Concentrations of Th, U, K, Mg, Ca, Mn, Fe, Zn, Co, and Cu are significantly different in two sections of a 1,000-ft core sample of Conway Granite. The differences, attributable to the action of weak hydrothermal fluids, indicate that the fluids, though weak, caused effective redistribution of these elements. — Authors' abstract

06740 **Brinkmann, D. J. L.** Nuclear magnetic resonance of ^{27}Al and ^{1}H in zoisite, $Ca_2Al_3Si_3O_{12}(OH)$[abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 20, 1969.

06741 **Broecker, Wallace S.** Why the deep sea remains aerobic [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 20-21, 1969.

06742 **Broecker, Wallace S.; vanDonk, Jan.** Insolation changes, ice volumes and the O^{18} record in deep sea cores [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 21, 1969.

06694 **Brookes, Ian A.** Late-glacial marine overlap in western Newfoundland: Canadian Jour. Earth Sci., v. 6, no. 6, p. 1397-1404, illus., tables, 1969.

In western Newfoundland Quaternary deposits comprise a glaciomarine sequence sandwiched between tills and associated glacial deposits derived from glaciers that moved westwards from highland centers of outflow. The upper marine limit, at 30.5 m-50 m in the area, was registered when ice of the earlier of the two glacial episodes represented wasted inland from the present shoreline. The dates herein reported indicate that in St. George's and Port au Port Bays this event was in progress 13,200-13,700 years ago, and that in fjord sites in the Bay of Islands it was delayed by about 1000 years. The diachronous nature of marine overlap in the area complicates the reconstruction of isobases on raised marine features. — Author's abstract

Brookins, D. G. *See* Chaudhuri, S. 06755

06690 **Brown, A. Sutherland.** Aiyansh lava flow, British Columbia: Canadian Jour. Earth Sci., v. 6, no. 6, p. 1460-1468, illus., tables, 1969.

The Aiyansh flow, about 220 years old, came from a vent in a narrow tributary valley of the Tseax River, flowed 14 miles to the Nass valley, and there spread out in a lava plain six miles long, forcing the river to the northern margin of the valley. The flow has an area of about 15 sq mi and a volume of about 0.1 cubic miles. It is a single cooling unit, the surface composed of pahoehoe, slab, and block lava in a pattern related to slope. Piping and collapse were important near the margins. The flow is entirely a fresh black alkali basalt varying only slightly in crystallinity and texture. Holocrystalline specimens from the interior consist of about 50 percent plagioclase, 10 percent olivine, 30 percent pyroxene, and 10 percent opaques. A new chemical analysis confirms that it is a high-iron, low-magnesium, alkali basalt. — *from* Author's abstract

07029 **Brown, G. E.; Gibbs, G. V.; Ribbe, P. H.** The nature and the variation in length of the Si-O and Al-O bonds in framework silicates: Am. Mineralogist, v. 54, nos. 7-8, p. 1044-1061, illus., tables, 1969.

Individual *T*-O distances decrease with increasing *T*-O-*T* angle. In addition, the *T*-O bond length is affected by types of *T* cations in *T*-O-*T* linkages, by the number and types of cations coordinating oxygen, and by the nontetrahedral cation-oxygen distance(s). Estimates of d-p π-overlap integrals for tetrahedral ions together with the correlations made between *T*-O bond lengths and *T*-O-*T* angles and data from X-ray emission studies suggest that the Si-O and Al-O bonds in framework alumino-silicates are similar in nature and that d-p π-bonding plays a significant role in their variation. — 00*from* Authors' abstract

Brown, L. Frank. *See* Flawn, Peter T. 06805

Brown, Noel K., Jr. *See* Bryant, William R. 07033

06424 **Brown, Thomas E.; Newland, Leo E.; Campbell, Donald H.; Ehlmann, Arthur J.** Field excursion, East Texas — Clay, glauconite, ironstone deposits — 18th Natl. Clay Conf., 1969: Texas Univ. Bur. Econ. Geology Guidebook 9, 48 p., illus., tables, 1969.

The field trip covers parts of ten counties and extends from the black prairie area of north-central Texas to the rolling, forested areas of the east. Major structural features crossed are the Tyler basin and Mexia-Talco fault zone. Salt domes are

discussed in the road log. Oldest rock units are Upper Cretaceous; the remaining area is underlain by Tertiary sediments. Glauconite is found only in the Eocene Claiborne Group, and iron in the Weches Formation. Soils are formed in place, are thus almost as old as parent rocks, and have highly developed horizons. — ESL

06743 **Brown, William M.; Ritter, John R.** Phenomenal erosion rates in the Eel River basin, California, may be the highest in North America [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 21-22, 1969.

06853 **Brownlow, Arthur H.; Mqhsen, Lotfi.** Distribution of manganese in the Philipsburg batholith, Montana and its relationship to associated manganese ore deposits [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 22, 1969; Econ. Geology, v. 64, no. 7, p. 835, 1969.

Brucker, Roger. *See* White, William B. 00012

06854 **Brush, Grace S.; Brush, Lucien M., Jr.** Transport of pollen in a sediment-laden channel — A laboratory study [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 23, 1969.

Brush, Lucien M., Jr. *See* Brush, Grace S. 06854

06855 **Bryan, Wilfred B.** Petrology of Isla Socorro, Mexico [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 23, 1969.

Bryant, William R. *See* Antoine, John W. 06496

Bryant, William R. *See* Cernock, Paul K. 06517

Bryant, William R. *See* Bowles, Frederick A. 06522

Bryant, William R. *See* Pyle, Thomas E. 06539

07033 **Bryant, William R.; Meyerhoff, A. A.; Brown, Noel K., Jr.; Furrer, Max A.; Pyle, Thomas E.; Antoine, John W.** Escarpments, reef trends, and diapiric structures, eastern Gulf of Mexico: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 12, p. 2506-2542, illus., table, 1969.

Dredging, coring and arcer profiling of the Florida escarpment southward from lat 28° 1.5′ N. southward to the Florida Strait, of Jorden Knoll in the Strait, and of Campeche escarpment northeast of Yucatan have revealed in all three areas late Aptian-Albian reef and forereef facies which lithologically and paleontologically are nearly identical to the Glen Rose-Stuart City reefs of the U.S. Gulf Coast and the El Abra-Golden Lane reefs of eastern Mexico. A deep-sea channel separated the Florida from the Campeche escarpment; Jorden Knoll may have been an early Cretaceous atoll. The complex geologic history of the eastern Gulf of Mexico since Early Cretaceous time is related to Middle Cretaceous and "Laramide" tectonic events in Cuba. An understanding of the events may lead to the discovery of petroleum accumulations in the region. — SEF

06887 **Bucknam, R. C.** Geologic effects of the BENHAM underground nuclear explosion, Nevada Test Site: Seismol. Soc. America Bull., v. 59, no. 6, p. 2209-2219, illus., 1969.

The BENHAM event, an underground nuclear explosion with a yield of about 1 megaton, produced linear fracture zones along previously mapped Basin and Range faults as far as 5.6 km from the explosion. The sense of vertical displacement on the faults and associated fractures is usually the same, with as much as 46 cm of vertical displacement and 15 cm of right-lateral displacement on the fractures. Displacements on the fractures reflect the release of tectonic strain triggered by the explosion; the parameters of the principal zone of fractures are similar to those expected for a natural earthquake of magnitude M = 6.0, which is also the instrumentally determined magnitude for the explosion reported by the U.S. Coast and Geodetic Survey. — Author's abstract

06856 **Buffler, Richard T.** Deformation of the Browns Park Formation in northwestern Colorado and its relationship to the late Tertiary tectonic history of the Rocky Mountains [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 23-24, 1969.

Bukry, D. *See* Heezen, B. C. 06736

00028 **Burchfiel, B. C.; Pelton, P. J.; Sutter, J.** An early Mesozoic deformation belt in south-central Nevada-southeastern California: Geol. Soc. America Bull., v. 81, no. 1, p. 211-216, illus., table, 1970.

Progress in tectonic syntheses of the Cordilleran orogen has led to the discovery that structural belts identified as geanticlines in earlier syntheses have later been identified as orogenic belts. Recent work in the Panamint and Inyo Ranges of southeastern California has demonstrated a major thrust system of Early Jurassic or Late Triassic age. The northeastward extension of this belt may be right-laterally displaced across the Las Vegas lineament to south-central Nevada where similar structures lead in a north-northeast direction toward central Nevada. If a further extension of this belt is found and better data on the dating of Mesozoic structural events is obtained in central Nevada, the long recognized Meso-Cordilleran geanticline may also become a deformational belt of early Mesozoic age. — *from* Authors' abstract

06561 **Burek, Peter J.** Device for chemical demagnetization of red beds: Jour. Geophys. Research, v. 74, no. 27, p. 6710-6712, illus., 1969.

Chemical demagnetization of red sandstones by means of high pressure HCl is an effective way of removing secondary magnetic components acquired in the modern weathering environments. — Author's abstract

06857 **Burek, Peter J.** The paleogeographic pattern of Europe and North America around the paleo-Mesozoic boundary and its significance for continental drift [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 24-25, 1969.

06858 **Burford, Arthur E.; Russ, David P.; Ryan, William M.** Tectonics of the Hurricane Ridge syncline, southeastern West Virginia [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 25, 1969.

06859 **Burger, H. Robert; Thompson, Margaret D.** Petrofabric investigation of fractures associated with folding [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 25-26, 1969.

06860 **Burger, H. Robert; Perry, Barbara E.; White, Brian.** Photoelastic investigation of pressure shadows [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 26, 1969.

06596 **Burke, Jack A.; Schmidt, A. W.; Campbell, Raymond L., Jr.** The litho-porosity cross plot — A method of determining rock characteristics for computation of log data: Log Analyst, v. 10, no. 6, p. 25-43, illus., tables, 1969.

Cross-plots of sonic versus density logs are widely used to interpret shaly sands, and density versus neutron cross-plots for carbonates, but when lithology is complex the data often become ambiguous. The litho-porosity cross-plot introduced here presents simultaneously the data from all three of the standard tools, from readings of which two porosity independent parameters are derived — M from the sonic and density, and N from the neutron and density logs. In the plot of M versus N, each pure mineral has a unique point, regardless of porosity; relative position of the log-data points aids in identifying various minerals in the complex formation; from lithologic information so derived accurate values of porosity can be calculated. Computer programmed, the method allows detailed studies and correlations in a fraction of time required with manual methods. Examples of applications are shown. — GDC

06861 **Burnham, C. Wayne; Davis, N. F.** Energy relations in water-bearing magmas [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 26-27, 1969.

Burns, Lary K. *See* Hay, R. L. 06730

06693 **Burwash, R. A.; Krupička, J.** Cratonic reactivation in the Precambrian basement of western Canada — [Pt.] 1, Deformation and chemistry: Canadian Jour. Earth Sci., v. 6, no. 6, p. 1381-1396, illus., 1969.

The broad, east northeast-west southwest striking mobile zone between Great Slave Lake and southern Alberta and central Saskatchewan (the Athabasca mobile zone) contains a high proportion of largely pre-Hudsonian crystalline rocks which underwent strong postcrystalline deformation and metasomatic recrystallization during the Hudsonian orogeny. There is a close relationship between the degree of postcrystalline (syncrystalline) deformation and the intensity of metasomatic recrystallization, and a high proportion of reworked older rocks. There is a strong influence of postcrystalline deformation upon isotopic age determination of the rocks, and the existence of microcline with low-grade minerals challenges the validity of microcline as a metamorphic facies index mineral. — *from* Authors' abstract

06862 **Burwash, R. A.; Krupička, J.** K-metasomatism of sub-continental dimensions [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 27, 1969.

06566 **Bushnell, Vivian C.; Ragle, Richard H.** (editors). Icefield Ranges Research Project scientific results, V. 1: New York, Am. Geog. Soc., and Montreal, Quebec, Arctic Inst. North America, 224 p., illus., tables, 1969.

The Icefield Ranges Research Project seeks understanding of the multiple facets that comprise the natural environment of the St. Elias Mountains of Alaska and Yukon Territory. The project has completed eight field seasons and the contents of this volume represent field work performed from 1961-65. These reports by both scholars and graduate students are original, graduate dissertations, or previously published papers; in the latter category present versions differ from the original in either matters of style, changes or omissions in illustrative material, and condensations of lengthy reports. The study area is regarded as a natural theater of investigation in glaciology. Fifteen papers in the physical sciences are cited separately. — MCM

06863 **Buttner, Peter J. R.** Molasse, managers, and model geology — Analysis, control and design with the aid of linear programming [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 27-28, 1969.

06864 **Buzas, Martin A.; Gibson, Thomas G.** Foraminiferal species diversity in the Cenozoic of the Atlantic margin [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 28, 1969.

00066 **Byerlee, James D.** Comments on paper by C. H. Scholz, M. Wyss, and S. W. Smith, "Seismic and aseismic slip on the San Andreas fault" [1969]: Jour. Geophys. Research, v. 75, no. 2, p. 499-500, illus., 1970.

Scholz and colleagues (ibid., v. 74, no. 8, p. 2049-2069, 1969) have applied Byerlee's theory of brittle fracture (1967) to the San Andreas fault system. It is pointed out here that the theory so far developed is applicable only to an ideal situation in which the normal and tangential forces are applied only at the tips of the asperities in contact. The fault plane solutions for the San Andreas fault are consistent with the fault's being a wavy surface on which contact is complete over the whole of the surface; thus the sliding surfaces are fully interlocked. There is no theory or experimental evidence to justify the assumption that the low stress drops calculated from seismic data for earthquakes along the San Andreas fault system, are due to a low value of friction. — DBV

Cailleux, André. *See* Billy, Cécile. 06459

06749 **Callender, Edward.** Origin and diagenesis of lacustrine carbonate minerals [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 29, 1969.

Campbell, Donald H. *See* Brown, Thomas E. 06424

06992 **Campbell, Kenneth E., Jr.** Comparing postcranial skeletons of Pliocene rabbits: Michigan Academician, v. 1, nos. 1-2, p. 99-115, illus., tables, 1969.

Partial skeletons of *Hypolagus* sp. *aff. H. vetus* and *Pratilepus vagus* were studied; measurements are tabulated. A comparison of characteristics of the skeletal elements indicates that *H.* sp. *aff. H. vetus* most closely resembled *Lepus europaeus* in its running habits; in size it approximated *L. californicus*. *Pratilepus vagus* resembled *Sylvilagus floridanus* in both size and running habits. These different running habits indicate the presence of both a marshy lowland and an adjacent upland in the Pliocene. — ESL

Campbell, Raymond L., Jr. *See* Burke, Jack A. 06596

Campbell, Russell B. *See* Hase, D. H. 06930

06599 **Canada Geological Survey.** Aeromagnetic series, Nippers Harbour, Newfoundland: Canada Geol. Survey Geophysics Paper 4444, scale 1:63,360, 1969.

06600 **Canada Geological Survey.** Aeromagnetic series, Skinner Cove, Newfoundland: Canada Geol. Survey Geophysics Paper 4445, scale 1:63,360, 1969.

06601 **Canada Geological Survey.** Aeromagnetic series, Gros Morne, Newfoundland: Canada Geol. Survey Geophysics Paper 4446, scale 1:63,360, 1969.

06602 **Canada Geological Survey.** Aeromagnetic series, Silver Mountain, Newfoundland: Canada Geol. Survey Geophysics Paper 4447, scale 1:63,360, 1969.

06603 **Canada Geological Survey.** Aeromagnetic series, Hampden, Newfoundland: Canada Geol. Survey Geophysics Paper 4448, scale 1:63,360, 1969.

06604 **Canada Geological Survey.** Aeromagnetic series, King's Point, Newfoundland: Canada Geol. Survey Geophysics Paper 4449, scale 1:63,360, 1969.

06605 **Canada Geological Survey.** Aeromagnetic series, Little Bay Island, Newfoundland: Canada Geol. Survey Geophysics Paper 4450, scale 1:63,360, 1969.

06606 **Canada Geological Survey.** Aeromagnetic series, Exploits, Newfoundland: Canada Geol. Survey Geophysics Paper 4451, scale 1:63,360, 1969.

06607 **Canada Geological Survey.** Aeromagnetic series, Trout River, Newfoundland: Canada Geol. Survey Geophysics Paper 4455, scale 1:63,360, 1969.

06608 **Canada Geological Survey.** Aeromagnetic series, Lomond, Newfoundland: Canada Geol. Survey Geophysics Paper 4456, scale 1:63,360, 1969.

06609 **Canada Geological Survey.** Aeromagnetic series, Cormack, Newfoundland: Canada Geol. Survey Geophysics Paper 4457, scale 1:63,360, 1969.

06610 **Canada Geological Survey.** Aeromagnetic series, Sheffield Lake, Newfoundland: Canada Geol. Survey Geophysics Paper 4458, scale 1:63,360, 1969.

06611 **Canada Geological Survey.** Aeromagnetic series, Springdale, Newfoundland: Canada Geol. Survey Geophysics Paper 4459, scale 1:63,360, 1969.

06612 **Canada Geological Survey.** Aeromagnetic series, Roberts Arm, Newfoundland: Canada Geol. Survey Geophysics Paper 4460, scale 1:63,360, 1969.

06613 **Canada Geological Survey.** Aeromagnetic series, Point Leamington, Newfoundland: Canada Geol. Survey Geophysics Paper 4461, scale 1:63,360, 1969.

06614 **Canada Geological Survey.** Aeromagnetic series, Comfort Cove, Newfoundland: Canada Geol. Survey Geophysics Paper 4462, scale 1:63,360, 1969.

06615 **Canada Geological Survey.** Aeromagnetic series, Carmanville, Newfoundland: Canada Geol. Survey Geophysics Paper 4463, scale 1:63,360, 1969.

06616 **Canada Geological Survey.** Aeromagnetic series, Musgrave Harbour, Newfoundland: Canada Geol. Survey Geophysics Paper 4464, scale 1:63,360, 1969.

06617 **Canada Geological Survey.** Aeromagnetic series, Sheet 2 F/6, Newfoundland: Canada Geol. Survey Geophysics Paper 4465, scale 1:63,360, 1969.

06618 **Canada Geological Survey.** Aeromagnetic series, Bay of Islands, Newfoundland: Canada Geol. Survey Geophysics Paper 4466, scale 1:63,360, 1969.

06619 **Canada Geological Survey.** Aeromagnetic series, Pasadena, Newfoundland: Canada Geol. Survey Geophysics Paper 4467, scale 1:63,360, 1969.

06620 **Canada Geological Survey.** Aeromagnetic series, Deer Lake, Newfoundland: Canada Geol. Survey Geophysics Paper 4468, scale 1:63,360, 1969.

06621 **Canada Geological Survey.** Aeromagnetic series, The Topsails, Newfoundland: Canada Geol. Survey Geophysics Paper 4469, scale 1:63,360, 1969.

06622 **Canada Geological Survey.** Aeromagnetic series, Gull Pond, Newfoundland: Canada Geol. Survey Geophysics Paper 4470, scale 1:63,360, 1969.

06623 **Canada Geological Survey.** Aeromagnetic series, Hodges Hill, Newfoundland: Canada Geol. Survey Geophysics Paper 4471, scale 1:63,360, 1969.

06624 **Canada Geological Survey.** Aeromagnetic series, Botwood, Newfoundland: Canada Geol. Survey Geophysics Paper 4472, scale 1:63,360, 1969.

06625 **Canada Geological Survey.** Aeromagnetic series, Gander River, Newfoundland: Canada Geol. Survey Geophysics Paper 4473, scale 1:63,360, 1969.

06626 **Canada Geological Survey.** Aeromagnetic series, Weir's Pond, Newfoundland: Canada Geol. Survey Geophysics Paper 4474, scale 1:63,360, 1969.

06627 **Canada Geological Survey.** Aeromagnetic series, Wesleyville, Newfoundland: Canada Geol. Survey Geophysics Paper 4475, scale 1:63,360, 1969.

06628 **Canada Geological Survey.** Aeromagnetic series, Cabot Islands, Newfoundland: Canada Geol. Survey Geophysics Paper 4476, scale 1:63,360, 1969.

06629 **Canada Geological Survey.** Aeromagnetic series, St. Brendans, Newfoundland: Canada Geol. Survey Geophysics Paper 4477, scale 1:63,360, 1969.

06630 **Canada Geological Survey.** Aeromagnetic series, Sheet 2 C/14, Newfoundland: Canada Geol. Survey Geophysics Paper 4478, scale 1:63,360, 1969.

06631 **Canada Geological Survey.** Aeromagnetic series, Sheet 2 C/15, Newfoundland: Canada Geol. Survey Geophysics Paper 4479, scale 1:63,360, 1969.

06632 **Canada Geological Survey.** Aeromagnetic series, Eastport, Newfoundland: Canada Geol. Survey Geophysics Paper 4480, scale 1:63,360, 1969.

06633 **Canada Geological Survey.** Aeromagnetic series, Bonavista, Newfoundland: Canada Geol. Survey Geophysics Paper 4481, scale 1:63,360, 1969.

06634 **Canada Geological Survey.** Aeromagnetic series, Sheet 2 C/10, Newfoundland: Canada Geol. Survey Geophysics Paper 4482, scale 1:63,360, 1969.

06635 **Canada Geological Survey.** Aeromagnetic series, Sweet Bay, Newfoundland: Canada Geol. Survey Geophysics Paper 4483, scale 1:63,360, 1969.

06636 **Canada Geological Survey.** Aeromagnetic series, Trinity, Newfoundland: Canada Geol. Survey Geophysics Paper 4484, scale 1:63,360, 1969.

06637 **Canada Geological Survey.** Aeromagnetic series, Sheet 2 C/7, Newfoundland: Canada Geol. Survey Geophysics Paper 4485, scale 1:63,360, 1969.

06638 **Canada Geological Survey.** Aeromagnetic series, Random Island, Newfoundland: Canada Geol. Survey Geophysics Paper 4486, scale 1:63,360, 1969.

06639 **Canada Geological Survey.** Aeromagnetic series, Old Perlican, Newfoundland: Canada Geol. Survey Geophysics Paper 4487, scale 1:63,360, 1969.

06640 **Canada Geological Survey.** Aeromagnetic series, Baie de Verde, Newfoundland: Canada Geol. Survey Geophysics Paper 4488, scale 1:63,360, 1969.

00036 **Cannon, William F.** Plutonic evolution of the Cutler area, Ontario: Geol. Soc. America Bull., v. 81, no. 1, p. 81-94, illus., 1970.

Staurolite, largely replaced by muscovite, quartz and clay minerals, occurs in the feldspathized contact aureole of the syntectonic Cutler batholith. Plagioclase and abundant biotite crystallized in the contact aureole because of introduction of Na from the granitic magma. Muscovite + quartz disappeared, but staurolite is believed to be a stable constituent at temperatures of the melting of granite at high pressures. — AH

00053 **Cappleman, Homer L., Jr.** Horizontal movements related to subsidence — Discussion [of paper 6336, by K. L. Lee and C. K. Chen, 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM 1, p. 310-317, illus., table, 1970.

The studies in paper 6336 (ibid., v. 95, no. SM 1, p. 139-166, 1969) are directed toward development of a method to predict places where transverse cracks may develop at the top of the dam. In the writer's experience, cracks that develop at lower elevations or in the foundation are more dangerous. Two aspects of the subject, the mechanics of subsidence and credibility of the beam analogy are discussed. — ESL

07010 **Card, K. D.; Meyn, H. D.** Geology of the Leinster-Bowell area, District of Sudbury: Ontario Dept. Mines Geol. Rept. 65, 40 p., illus., tables, geol. map, 1969.

Oldest rocks in the Leinster-Bowell area, mafic metavolcanics with pelitic metasedimentary and iron-formation interbeds, have been intruded and granitized to produce migmatites and gneisses. A batholith, mainly quartz monzonite, emplaced during and after migmatization, underlies the central part. Huronian quartzites and conglomerates which unconformably overlie older rocks are intruded by gabbroic rocks, Sudbury Nickel Irruptive, Foy Offset dike, and late olivine diabase dikes. Rocks, except late diabase dikes and possibly the irruptive, have been subjected to repeated deformation. Major north-trending faults were active during and after various orogenic events. Pleistocene glaciation resulted in removal of soil and in local glacial and glaciofluvial deposition. There is one past-producing nickel-copper mine, and also sulfide mineral occurrences, lead-zinc mineralization, and a banded iron formation. — *from* Authors' abstract

Carder, D. S. *See* Cloud, William K. 06893

06537 **Carlson, Paul R.; Nelson, C. Hans.** Sediments and sedimentary structures of the Astoria Submarine Canyon-Fan system, northeast Pacific: Jour. Sed. Petrology, v. 39, no. 4, p. 1269-1282, illus., table, 1969.

Cores from this system illustrate typical lithology and structure of sediments in these environments. Deposits are late glacial and postglacial in age. The canyon and fan deposits can be identified as related because of the laterally continuous contacts between postglacial and glacial sediments, distinctive mineral and faunal compositions, and rhythmically interbedded turbidites and hemipelagites. Homogeneous silty clay beds dominate canyon deposits, which also contain more organic material and glauconite and show more evidence of slumping than do the fan deposits. The fan deposits contain numerous, thick, coarse, well-sorted sand and silt beds that exhibit well-developed internal structures. Distinctions can also be made between deposits from different parts of the fan. — *from* Authors' abstract

Carmichael, I. S. E. *See* Peterman, Zell E. 00040

00020 **Carozzi, Albert V.** New historical data on the origin of the theory of continental drift: Geol. Soc. America Bull., v. 81, no. 1, p. 283-285, 1970.

Examination of the original texts of Francis Bacon's *Novum Organum* (1620) and of Francois Placet's *La Corruption du grand et petit monde* (1668) shows, that contrary to common belief, these two authors should not be considered as forerunners of the theory of continental drift; this conclusion also applies to A. von Humboldt (1801). A. Snider, in *La Creation et ses Mysteres devoiles* (1858), is the first naturalist who has unequivocally postulated and illustrated a juxtaposition and drifting of the continents as Taylor and Wegener did in the twentieth century. — Author's abstract

06750 **Carpenter, Robert H.** Metamorphic history of the Blue Ridge province of Tennessee and North Carolina [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 29, 1969.

06416 **Carr, P. A.; VanDerKamp, G. S.** Determining aquifer characteristics by the tidal method: Water Resources Research, v. 5, no. 5, p. 1023-1031, illus., tables, 1969.

If ground-water levels of a confined aquifer fluctuate with sea tides, individual values of hydraulic conductivity and specific storage can then be determined. Apparent tidal efficiency and time lag are first calculated from the water level data recorded at an observational device situated inland from the sea, taking into account the response characteristics of the observational device according to criteria established by Hvorslev (1951). The true tidal efficiency of the aquifer at the seacoast is then determined from the apparent tidal efficiency and used to obtain the specific storage. This and the tidal time lag are utilized to calculate the hydraulic conductivity. The method was tested in Prince Edward Island, Canada, and yielded results compatible with pump test data. This is a simple and inexpensive way to test a confined aquifer in the coastal environment. — Authors' abstract

06593 **Carroll, R. D.** The determination of the acoustic parameters of volcanic rocks from compressional velocity measurements: Internat. Jour. Rock Mechanics and Mining Sci., v. 6, no. 6, p. 557-579, illus., tables, 1969.

A statistical study was made of the relation of acoustic parameters of volcanic rocks to compressional wave velocities for data obtained in a volcanic region in Nevada; additional samples, chiefly granitic rocks, were included also. Laboratory acoustic measurements obtained on 62 dry core samples were grouped with similar measurements from geophysical logging devices at several depth intervals in a hole from which 15 core samples were obtained. Effects of lithostatic and hydrostatic load on changing rock acoustic parameters measured in the hole were noticeable when compared with laboratory measurements on the same core. Results of analyses determined by grouping all data, indicate that dynamic Young's, shear and bulk modulus, shear velocity, shear and compressional characteristic impedance, and amplitude and energy reflection coefficients may be reliably estimated on basis of compressional wave velocities. — *from* Author's abstract

06751 **Carson, Bobb; McManus, Dean A.** The stratigraphy of northern Cascadia Basin — A statistical evaluation [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 30, 1969.

Carson, D. J. T. *See* Muller, J. E. 06657

06752 **Carver, Robert E.** Sedimentology of microscopic opal in Tertiary rocks of the Atlantic Coastal Plain [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 30-31, 1969.

06507 **Case, C. M.; Domenico, P. A.; Zeizel, E. P.; Crouse, L.** Ground-water use in stabilizing surface water supply, *in* Engineering geology and soils engineering symposium, 7th Ann., Moscow, Idaho, 1969, Proc.: Boise, Idaho, Idaho Dept. Highways, p. 101-115, illus., tables, 1969.

This report applies a mathematical model that tests the feasibility of using large scale ground-water withdrawals to supplement surface flow for current irrigation use. If such pumping is economically feasible, the model can be used to determine the optimum size of the pumping plant that can be used. — DBV

06753 **Castillo, F.; Miller, S. L.** A miniaturized automated system for the analysis of amino acids, purines and pyrimidines for the detection of extraterrestial life [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 31, 1969.

06559 **Centolanzi, Frank J.** Maximum tektite size as limited by thermal stress and aerodynamic loads: Jour. Geophys. Research, v. 74, no. 27, p. 6723-6735, illus., tables, 1969.

An experimental investigation has been conducted on the thermal stresses induced in tektites cooled by radiation in space. The stresses were measured with conventional photoelastic techniques and correlated with computed temperature differences. The results show that the internal tensile stresses increase with size until fracturing occurs. The largest tektite sphere that could survive the stresses from both radiation cooling and atmosphere entry is limited by thermal stress and is estimated to be of the order of 1 kg. The largest cylinder is restricted by a combination of a thermal stress limit on diameter and an aerodynamic load limit on length, and is estimated to be of the order of 100 kg. Because the tektites break up in the atmosphere, these limits represent the approximate maximum size that could be expected to impact the ground at one spot. — Author's abstract

06517 **Cernock, Paul K.; Bryant, William R.** Salinities of interstitial waters from selected sediments in the Gulf of Mexico: Jour. Sed. Petrology, v. 39, no. 4, p. 1633-1639, illus., tables, 1969.

Salinities of three sediment cores have been determined by the Knudsen titration method and an inductive salinometer. Differences in salinity as large as 2 per mille have been found between the two methods for interstitial waters from blue clays, whereas no differences were observed for the waters from coarser calcareous lutite. Decrease in salinity with depth shown by the inductive method for blue clay sediment is due to exchange and adsorption of ions by clay minerals, preferential precipitation of ionic compounds, or some type of diagenesis. Decrease in salinity with depth is associated with decrease in water content and all of these samples contain the greatest percentage of clay-sized particles. Ultrafiltration processes probably have not been active in any of the cores. — *from* Authors' abstract

00022 **Chadwick, Robert A.** Belts of eruptive centers in the Absaroka-Gallatin volcanic province, Wyoming-Montana: Geol. Soc. America Bull., v. 81, no. 1, p. 267-273, illus., table, 1970.

Two northwest-trending belts of eruptive centers, termed the Eastern Absaroka belt and the Western Absaroka belt, extend northwestward from the southeastern part of the Absaroka Range through the Gallatin Range. The belts were evidently zones of crustal weakness dating from Laramide or earlier time and lasting into the early Tertiary, when they served as conduits for volcanic and intrusive rocks of the Absaroka-Gallatin volcanic field. Igneous rocks of the Eastern Absaroka belt are more potassic than those of the Western Absaroka belt. — Author's abstract

00025 **Chamberlain, E. W.; Stanley, R. S.** Mechanical analog calculator for three-dimensional rotation problems: Geol. Soc. America Bull., v. 81, no. 1, p. 247-253, illus., table, 1970.

A mechanical analog calculator (Geomac) has been developed that can be used for rotation programs in such fields as structural petrology, mineralogy, and paleomagnetism. The device consists of a group of concentric circles and arcs on which the problem is reconstructed, and the solution is found. In terms of precision, speed, and ease of operation, the calculator is thought to be superior to stereographic solutions and preferable to digital computer programs for problems involving a small number of data. — Authors' abstract

Chamberlain, J. A. *See* McLeod, C. R. 06658

06518 **Chanda, S. K.** Calclithite fragments versus extracts — A discussion [of 1959 paper by R. L. Folk, and 1965 paper by K. H. Wolf]: Jour. Sed. Petrology, v. 39, no. 4, p. 1640-1641, illus., 1969.

The synonomy of calclithite fragments and extraclasts is misleading. Genetically they represent two distinctly different types of materials and the terms should not be used as substitute for each other. — Author's abstract

06882 **Chandler, R. R., Jr.** Bay Area Rapid Transit System, Field Trip 4 *in* 1969 field trips — Assoc. Eng. Geologists, Natl. Mtg., San Francisco, Calif., 1969: [Berkeley, Calif.] Assoc. Eng. Geologists, p. D1-D7, illus., 1969.

This is the guide book to the field trip covering the Bay Area Rapid Transit System. The design was based on structures that would be able to accept the deformations imposed by seismic action without causing objectionable permanent distortion, keep the risk to passengers and system within acceptable limits, and still make the project economically feasible. — DBV

06754 **Chang, Luke L. Y.** Subsolidus phase relations in binary carbonate systems involving aragonite [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 31-32, 1969.

06755 **Chaudhuri, S.; Brookins, D. G.** Rb-Sr ages of Late Precambrian rocks of Wisconsin [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 32, 1969.

Chessman, Mary. *See* Horai, Ki-iti. 00015

06756 **Cho, Seung-Am; Wuensch, B. J.** The crystal structure of plagionite, $Pb_5Sb_8S_{17}$ [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 33, 1969.

Chodos, A. A. *See* McGetchin, T. R. 00067

Chodos, Arthur A. *See* Albee, Arden L. 07011

00050 **Chowdhury, R. N.; Richards, Rowland, Jr.; Coates, Donald F.** Slopes in stiff-fissured clays and shales — Discussion [of paper 6449 by J. M. Duncan and P. Dunlop, 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM 1, p. 336-344, illus., table, 1970.

Chowdhury believes that the high initial shear stresses should be emphasized rather than the horizontal stresses before excavation to insure a safety factor corresponding to development of local failures as concluded by Duncan and Dunlop (ibid., v. 95, no. SM 2, p. 467-492, 1969); excavation analysis involves many steps. Richards indicates that the disparity in paper 6449 which involves shear stresses is one of precision which could be overcome by use of a computer. Coates elaborates on the concept of applying a change of stress on an excavation surface by using photoelastic slope models, some of which are illustrated. — MCM

06757 **Christ, C. L.; Hostetler, P. B.** Thermodynamic solubility of magnesite [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 33-34, 1969.

Christ, Charles L. *See* Clark, Joan R. 06760

Cita, Maria B. *See* Gartner, Stefan, Jr. 06818

06758 **Clark, G. Michael.** Preliminary distribution, characteristics and origin of some Appalachian sorted patterned ground localities south of the glacial border [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 34, 1969.

06759 **Clark, G. R., 2d.** Daily growth lines in the bivalve family Pectinidae [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 34-35, 1969.

Clark, J. F. *See* Andrieux, P. 06702

06760 **Clark, Joan R.; Konnert, Judith A.; Christ, Charles L.** Crystal structures and origin of two borate minerals, veatchite and fabianite [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 35, 1969.

07048 **Clark, M. C.; Key, M. H.; Pert, G. J.** Ice-resistivity measurements on Paris Gletscher, East Greenland [with French and German abs.]: Jour. Glaciology, v. 8, no. 54, p. 369-373, illus., table, 1969.

D. C. ice-resistivity measurements on the polar Paris Gletscher in East Greenland are presented. It is found that the observed profile is well described by a four-layer system. Near the surface there are two layers resulting from the penetration of the summer temperatures into the polar ice. Below this the ice has constant resistivity until the bed is reached, where contrary to expectation a high-resistivity layer is found [not thought due to underlying rock]. — Authors' abstract

06666 **Clark, W. A., Jr.** In memoriam, Robert Lowell Benish (1913-1969): Houston Geol. Soc. Bull., v. 12, no. 4, p. 23, 1969.

06985 **Clarke, Garry K. C.** Geophysical measurements on the Kaskawulsh and Hubbard Glaciers, *in* Icefield Ranges Research Project scientific results, V. 1 (V. C. Bushnell and R. H. Ragle, editors): New York, Am. Geog. Soc., and Montreal, Quebec, Arctic Inst. North America, p. 89-103, illus., tables, reprinted 1969; originally published 1967.

Gravity and seismic measurements were used to determine ice thickness in the divide region of Kaskawulsh and Hubbard Glaciers. For a 107-station network, Bouguer anomalies ranged from -199.8 to -162.9 mgal. Ice thickness calculations were made assuming the glacier was an infinite slab. Seismic refraction lines gave a firn thickness of about 40 m and an average P-wave velocity of 3710 ± 20 m/sec. Maximum ice thicknesses and surface flow rates were 778 m and 150 m/yr on Kaskawulsh and 539 m and 132 m/yr on Hubbard. A close relation was found between geophysically-determined ice thicknesses and surface flow measurements. Flow and valley center lines were roughly coincident; flow was complicated by tributary glaciers. Topographic and flow divides were the same but no corresponding bedrock divide was found. [Originally published as Arctic Inst. North America Tech. Paper 20, 1967.] — *from* Author's abstract

Clarke, J. D. *See* Bell, J. R. 06492

Clarke, O. M., Jr. *See* LaMoreaux, P. E. 06649

00008 **Clarke, W. B.; deLaeter, J. R.; Schwarcz, H. P.; Shane, K. C.** Aluminum-26 — magnesium 26 dating of feldspar in meteorites: Jour. Geophys. Research, v. 75, no. 2, p. 448-462, illus., tables, 1970.

"Fossil" Mg-26 from the decay of Al-26 has been detected in the feldspar phase of several stone meteorites. Measurement of the Mg contents of the separated feldspar phases allowed a calculation of Mg-26 (radiogenic) relative to $Si = 10^6$ atoms. It is concluded that (1) the feldspar of some meteorites cooled to below the temperature of Mg diffusion within about 3 m.y.; (2) no more than 5 m.y. elapsed between the end of Al-26 production and formation of the feldspar phase in some meteorites; (3) the process that produced Al-26 in the early history of the solar system was of short duration (<5 m.y.); (4) if levels of Al-26 inferred from excess Mg-26 were present at the time of formation of objects only a few tens of km in radius, sufficient energy would have been produced by radioactive decay of Al-26 to heat the centers of these objects to near their melting point. — DBV

06953 **Cleary, J. R.; Muirhead, K. J.** Comparison of the 1968 P tables with times from nuclear explosions — [Pt.] 1, Longshot and Greeley: Earth and Planetary Sci. Letters, v. 7, no. 2, p. 119-124, illus., tables, 1969.

The chief differences between recent determinations of the P traveltime curve beyond about 24° may be expressed, in each case, as a deviation in the slope of the curve which is approximately constant throughout the range. If one of these curves is used to calculate the residuals of P times from a seismic event, with station corrections applied, then it is possible to solve simultaneously for the value of this deviation and for the source correction. This has been done for the nuclear explosions

Longshot and *Greeley*, using the 1968 P tables and the Herrin-Taggart station corrections. In both cases the calculated deviation was close to that of the Cleary-Hales curve. The analysis of the *Longshot* data was repeated using the times and station corrections derived by Lilwall and Douglas, and essentially the same result was obtained. — Authors' abstract

06575 **Clifton, H. Edward.** Beach lamination — Nature and origin: Marine Geology, v. 7, no. 6, p. 553-559, illus., 1969.

A distinctive two-fold sedimentation unit characterizes the lamination in the upper swash zone of beaches. Within the unit a fine and/or a heavy mineral rich layer at the base grades upward into a coarser and/or a heavy mineral poor layer at the top. This distinctive type of lamination results from the grain segregation with bed flow during backwash. — Author's summary

06761 **Clifton, H. Edward.** The undersea laboratory as a geological research tool — Lessons from Tektite I [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 36, 1969.

06893 **Cloud, William K.; Carder, D. S.** Ground effects from the BOXCAR and BENHAM nuclear explosions: Seismol. Soc. America Bull., v. 59, no. 6, p. 2371-2381, illus., table, 1969.

Formulas were developed by the authors in 1957 for the purpose of estimating maximum ground accelerations and transitory displacements resulting from the 1.7 kt RAINIER shot and subsequent underground nuclear detonations. These formulas when extrapolated more than 4 orders of magnitude upward came within a half order of magnitude of predicting ground motion data resulting from the BOXCAR and BENHAM underground detonations. Velocity response spectrums from these shots made in the distance range of 20 km, more or less, closely resembled the velocity response spectrums from a magnitude 6.6 earthquake in the same distance range. — Authors' abstract

Coates, Donald F. *See* Chowdhury, R. N. 00050

06762 **Coates, Donald R.** Terrain comparison of the glaciated and non-glaciated Appalachian Plateau [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 36-37, 1969.

06542 **Cohee, George V.** High Dinsmore Miser (1884-1969): Am. Assoc. Petroleum Geologists Bull., v. 53, no. 12, p. 2560-2562, portrait, 1969.

06763 **Cohen, Arthur D.** Early stages in the "coalification" of plant fragments in southern Florida peats [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 37, 1969.

06764 **Colburn, Ivan P.** Paleocurrent framework for the Cretaceous continental margin in California [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 38, 1969.

06679 **Coleman, Babette B.; Ehrle, Elwood B.** A description of the Genesee Country, *in* Studies on the plants of the Genesee Country (western New York State): Rochester Acad. Sci. Proc., v. 12, no. 1, p. 13-23, illus., tables, 1969.

When the compacted Ordovician-Devonian sea-bottom sediments underlying the area developed a dip to the south, a south-trending drainage pattern developed. The area was also affected by the Appalachian revolution and a Tertiary uplift, and as erosion exposed east-west trending beds, cuesta fronts and east-west river valleys developed. Two major invasions of continental glaciation contributed to the diversified physiography. Changes in the drainage patterns due to glaciation are described, especially in the Genesee River. Climatic data are tabulated. The northern part of Genesee Country is dominated by glacial and alluvial soils, whereas the southern section is dominated by soils developed from varied bedrock material. Sources and migration of forests are discussed. — ESL

06765 **Collinson, Charles; Avcin, Matthew J.; Avcin, Susan B.** New conodont zonation of the Mississippi Valley Burlington Formation (Mississippian) [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 38, 1969.

06766 **Comer, John B.** Sedimentology and physical-chemical environment of a tropical lagoon, western Puerto Rico [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 39, 1969.

06555 **Comerford, M. F.** Meteorites — An X-ray analysis of deformed kamacite: Jour. Geophys. Research, v. 74, no. 27, p. 6675-6678, illus., table, 1969.

An X-ray line-broadening analysis was carried out to study the degree and nature of lattice damage that is present in the kamacite phase of iron meteorites. Single plates of kamacite were removed from three octahedrites, and diffraction-line profiles were measured on a spectrometer for several orders of (110) and (200) reflections. With identical X-ray geometry, corresponding line-profile measurements were made of the (110) and (200) reflections from an annealed single crystal in order to correct for inherent geometrical breadths. The contributions of the two principal factors affecting kamacite line breadth, that is, particle size and elastic strain, have been evaluated. The results are examined in the light of the probable state of the kamacite as inferred from metallographic observations. — Author's abstract

06442 **Condie, Kent C.; Madison, James A.** Compositional and volume changes accompanying progressive serpentinization of dunites from the Webster-Addie ultramafic body, North Carolina: Am. Mineralogist, v. 54, nos. 7-8, p. 1173-1179, illus., 1969.

Chemical and modal analyses of 22 partially serpentinized dunites from the Webster-Addie ultramafic body in North Carolina suggest losses of Mg and Fe, additions of Si and Na, and an increase in volume during progressive serpentinization of the dunites. — Authors' abstract

07043 **Conrad, Omar G.** Tertiary volcanic rocks of Needles Range, western Utah: Utah Geol. and Mineralog. Survey Spec. Studies 29, 28 p., illus., geol. map, 1969.

The northern half of the Needles Range is an eastward-tilted, fault-block mountain range. Detailed field study of ignimbrite layers shows three main units (herein named) beneath the Isom and Needles Range Formations: (from bottom to top) Indian Peak, Sawtooth Peak, and Beers Spring Formations. Using ignimbrite layers as stratigraphic units, regional structural events may be interpreted as: southern part began to subside during late Eocene or early Oligocene, shortly after initiation of ignimbrite-producing eruptions; subsidence became localized as an eastward-trending trough, later filled by several successive ignimbrites; and sinking continued intermittently throughout deposition of Needles Range and Isom Formations during mid-Oligocene. During late Oligocene, major normal faults produced the northerly trend and easterly tilt of Needles Range. — *from* Author's abstract

06767 **Cook, David O.** Sand transport by shoaling waves [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 39-40, 1969.

06936 **Cook, Donald J.** Heavy minerals in Alaskan beach sand deposits: Alaska Univ. Mineral Industry Research Lab. Rept. 20, 114 p., illus., tables, 1969.

Mineral composition of present and submerged beaches dependent upon nature of source rock consists of those minerals having greater resistance to weathering and transportation processes. Heavy minerals likely to be constituents are those containing titanium, zirconium, rare-earths, columbium-tantalum, chromium, iron, and precious metals. Discussion of each includes original occurrence and uses. World occurrences of submerged and exposed sand deposits rich in heavy minerals include Florida, New Jersey, and Alaska. Samples from the following Alaskan areas were analyzed: Yakataga, Lituya Bay, Bradfield Canal-Ketchikan, Nome, Bristol Bay, and Cook Inlet. Some of these have been mined for precious metals, but none for heavy metals. Suggestions are made for further studies in evaluating the deposits and in mining methods. — ESL

06768 **Coombs, Howard A.** Mossyrock dam site, Cowlitz River, Washington [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 40, 1969.

Cooper, J. F., Jr. *See* Dunning, G. E. 06454

Copeland, C. W. *See* LaMoreaux, P. E. 06649

Cording, Edward J. *See* Deere, Don U. 06499

Córdoba M., Diego A. *See* Anderson, Thomas H. 06828

06769 **Craig, James R.; Harris, Rae L.; Kullerud, Gunnar; Howe, David A.** The Loop meteorite — A new olivine-bronzite chondrite [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 40, 1969.

06770 **Cramer, Howard Ross.** Permian rocks in the Sublett basin, central southern Idaho [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 41, 1969.

06771 **Crawford, A. R.; Wilson, J. T.** Continental drift in the Arctic and Indian Oceans and before the Mesozoic era [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 41-42, 1969.

Crecelius, Erich A. *See* Bockheim, James G. 06385

06772 **Cross, Aureal T.** Coal-balls — Their origin, nature, geologic significance and distribution [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 42, 1969.

Crouse, L. *See* Case, C. M. 06507

06773 **Cumming, L. M.** Ordovician lithofacies, northern Manitoba [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 42, 1969.

06445 **Czamanske, Gerald K.; Larson, Richard R.** The chemical identity and formula of argentopyrite and sternbergite: Am. Mineralogist, v. 54, nos. 7-8, p. 1198-1201, tables, 1969.

Sternbergite and argentopyrite have the same formula: $AgFe_2S_3$, as shown by chemical analysis and uncorrected microprobe comparisons. Previous X-ray data indicate different structures for the two minerals. — Authors' abstract

Dachille, Frank. *See* Gigl, Paul D. 06704

06774 **Dahlberg, Eric C.** Simulation of postulated geologic phenomena [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 43, 1969.

06775 **Damberger, Heinz H.** Clastic dikes (veins) in Pennsylvanian coal seams of the Illinois basin [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 43, 1969.

00060 **Daneš, Z. F.** Earthquake occurrence in the state of Washington: Science, v. 167, no. 3917, p. 396, 1970.

A time-lapse film of earthquake occurrences in the state of Washington reveals a remarkable story of alinements of epicenters, earthquake swarms, stress buildup and release, and other features. The lines along which earthquake swarms occur are in complete agreement with offsets of gravity trends revealed by a previous analysis (1960), and pass almost exactly through the andesitic Cascade volcanoes. It is conceivable that the volcanoes develop along those planes of offset where fresh basalts come in contact with the acidic batholith, and are thus quartz-enriched. — DBV

Daniel, T. W., Jr. *See* LaMoreaux, P. E. 06649

Davies, Geoffrey F. *See* Ahrens, Thomas J. 00006

Davis, Edward H. *See* Viggiani, Carlo. 00051

06776 **Davis, John C.; Preston, Floyd W.** Optical processing — An attempt to avoid the computer [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 44, 1969.

06777 **Davis, Mary W.; Ehrlich, Robert.** Theoretical investigation of the nature and utility of size frequency distribution measures [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 44, 1969.

Davis, N. F. *See* Burnham, C. Wayne. 06861

00070 **Day, R.; O'Reilly, W.; Banerjee, Subir K.** Rotational hysteresis study of oxidized basalts: Jour. Geophys. Research, v. 75, no. 2, p. 375-386, illus., tables, 1970.

The rotational hysteresis method, whereby rotational hysteresis (W_R) is measured as a function of magnetic field (H), has been applied to basalts that have been classified optically into different oxidation states. The W_R - H curves show characteristic shapes for classes 1 to 5. These curves were interpreted in terms of theoretical and experimental data. It is concluded that measurement of rotational hysteresis for fields up to 21,000 oe provides a nondestructive complementary technique for studying the oxidation state of basalts. Additionally, it is found that highly oxidized basalts contain large amounts of hematite or hemo-ilmenite which are magnetically very hard. By studying the change in shape of the W_R - H curves on heating synthetic titanomagnetites, it was possible to postulate a model for the oxidation-induced phase changes in natural titanomagnetites. — DBV

06652 **Dean, Thomas J.; Jenkins, Gomer; Williams, James H.** Underground mining in the Kansas City area: Missouri Mineral Industry News, v. 9, no. 4, p. 37-56, illus., 1969.

Commercial mining in the Kansas City area started before 1900 in surface strip pits on outcrop lines, with thin overburden. The Bethany Falls Limestone was extensively quarried, with the Hushpuckney Shale as the working base; this also applies to modern underground quarries. A diagrammatic column of the Pennsylvanian Kansas City Group includes the formations important in mining. Planning in order to leave usable underground floor space, and to prevent roof failure and collapse is discussed. Some of the more common problems in opening and using an underground limestone mine are: type and thickness of overburden, ground water, mine design and development, stability, mine-life expectancy, and mining economics. — ESL

06778 **Dean, Walter E., Jr.** Freshwater iron-manganese "nodules" in Oneida Lake, New York [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 45, 1969.

06400 **Deep Sea Drilling Project.** (Scientific Staff). Deep Sea Drilling Project, Leg 7: Geotimes, v. 14, no. 10, p. 12-13, illus., 1969.

During Leg 7, between Guam and Honolulu, a total of seven sites in four geologic provinces was drilled. The first site was in the Marianas Basin, east of the Trench; three sites along a line parallel to the equator and in the Caroline — Ontong Java region; two within the Central Basin; and one on the Hawaiian Arch, north of Oahu. The core from Hawaii showed consolidated and bedded volcanic sandstone and mudstone, and dark brown clay for 60 m where a layer of hard brown chert stopped the bit. Only about half of the total column, as inferred from seismic profiles, was penetrated. — ESL

06499 **Deere, Don U.; Cording, Edward J.** Interrelationships of soil mechanics, rock mechanics, and engineering geology [abs.], *in* Engineering geology and soils engineering symposium, 7th Ann., Moscow, Idaho, 1969, Proc.: Boise, Idaho, Idaho Dept. Highways, p. 1, 1969.

DeFazio, Thomas. *See* Aki, Keiiti. 06886

DeLaeter, J. R. *See* Clarke, W. B. 00008

Dellwig, L. F. *See* Wing, R. S. 00042

06993 **Delorme, L. D.** Ostracodes as Quaternary paleoecological indicators: Canadian Jour. Earth Sci., v. 6, no. 6, p. 1471-1476, illus., table, 1969.

Quantitative and specific distribution of ostracodes are dependent on the physical and chemical limitations imposed by their environment, which in turn are controlled by geological, hydrological, botanical, and climatic factors. Once the nature of these controls has been defined for a region, the ecological limitation of specific ostracodes can be determined. Knowing the ostracode's tolerance limits then allows one to reconstruct the environments of the past, through paleoclimatic, paleoecologic, paleogeologic, and paleohydrologic interpretations. — Author's abstract

06779 **Dennen, William H.; Moore, Bruce R.** Si-Fe-Al ratios and the classification of clastic sediments [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 45, 1969.

06780 **Dennison, John M.** Statistical meaning in geologic field work [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 45-46, 1969.

Denny, Charles S. *See* Ray, Clayton E. 00038

06553 **Denton, George H.; Stuiver, Minze.** Neoglacial chronology, northeastern St. Elias Mountains, Canada, *in* Icefield Ranges Research Project scientific results, V. 1 (V. C. Bushnell and R. H. Ragle, editors): New York, Am.Geog.Soc., and Montreal, Quebec, Arctic Inst.North America, p. 173-186, illus., tables, reprinted 1969;originally published 1966.

This paper was published originally in Am. Jour. Sci., v. 264, no. 8, p. 577-599, 1966; *see* Abstracts of North American Geology, August 1967. — MCM

Denton, George H. *See* Stuiver, Minze. 06701

06467 **Derby, James R.** Revision of Lower Ordovician-Middle Ordovician boundary in western Arbuckle Mountains, Oklahoma, *in* Regional geology of the Arbuckle Mountains, Oklahoma: Oklahoma Geol. Survey Guidebook 17, p. 35-37, table, 1969.

The boundary falls within the West Spring Creek Formation; the uppermost 90 feet of Arbuckle strata is Middle Ordovician in age; a major faunal change in the brachiopod, conodont, and ostracode faunas is present about 100 feet below the top of the Group; the fauna of the upper 90 feet of the West Spring Creek Formation is more related to the fauna of the overlaying Joins Formation than to that of the underlying West Spring Creek Formation. These conclusions suggest that no major hiatus is present at the top of the Arbuckle, but one may be present within the Arbuckle. The trilobite fauna does not show the same significant change, however. — *from* Author's conclusions

06867 **Desai, K. P.; Helander, D. P.; Moore, E. James.** Sequential measurement of compressional and shear velocities of rock samples under triaxial pressure: Soc. Petroleum Engineers Jour., v. 9, no. 4, p. 378-394, illus., tables, 1969.

A new laboratory system, designed with titanate zirconate transducers for precise measurement of compressed wave velocity, and with AC-cut quartz transducers for sequential measurement of shear wave velocities of rock samples under triaxial pressure, was tested on standard samples such as aluminum, steel, brass and lucite, with an accuracy within one percent. Measurements on samples of Berea and Bartlesville sandstones indicate: both compressional and shear velocities increase with increases in external pressure at constant internal pressure; compressional velocity depends upon both external and internal pressure, shear velocity only upon differential pressure; nature of fluid saturation in the rock has little effect on compressional velocity, but shear velocity decreases with increase in density of saturant; anisotropy appears to be negligible in the Berea sandstone, but definite for the Bartlesville sandstone. — GDC

06781 **DeVore, George W.** Elastic strain energy relations in twinned feldspar and amphibole crystals [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 46, 1969.

06868 **DeVore, George W.** Differential thermal contractions and compressibilities as a cause for mineral fracturing and annealing: Wyoming Univ. Contr. Geology, v. 8, no. 1, p. 21-36, illus., tables, 1969.

Natural mineral fracturing in rocks is evaluated in terms of anisotropic thermal and elastic properties of crystals; models are proposed for calculating anisotropic thermal stresses. Computed thermal stresses that result from differential thermal contractions, with reasonable temperature change, between different coexisting minerals or between the same minerals of different orientation are adequate to cause brittle rupture of the crystals or provide elastic strain energies for annealing recrystallization. Thermal strains are relieved by brittle rupture in the ferromagnesian minerals, whereas in the quartz-feldspar system, annealing recrystallization is the mechanism. Fracture stress is evaluated in terms of theoretical cohesive strength of minerals. It is proposed that the modulus of rigidity, less than half the value of Young's modulus, be substituted for it in the descriptive fracture stress equation. — *from* Author's abstract

06699 **Dewart, G.** Moulins on Kaskawulsh Glacier, *in* Icefield Ranges Research Project scientific results, V. 1 (V. C. Bushnell and R. H. Ragle, editors): New York, Am. Geog. Soc., and Montreal, Quebec, Arctic Inst. North America, p. 145-146, illus., 1969.

Moulins on Kaskawulsh Glacier, examined in 1965, were located near the confluence of the central and north arms, about 8 km below the firn line and 40 km from the terminus, where elevation is about 1,750 m and ice about 500 m thick. Near the main moulin is a series of smaller ones associated with closing crevasses of an ice fall about 1 km up the central arm. Most moulins started as nearly vertical shafts but changed direction and contained more or less prominent ledges at depth, the largest inactive one being about 2 m in diameter and dropping vertically for at least 60 m. Moulins were found useful as ready-made seismic shot holes. — MCM

Diamond, W. G. *See* Stroud, Raymond B. 06672

Dickey, D. D. *See* McKeown, F. A. 06885

06888 **Dickey, D. D.** Strain associated with the BENHAM underground nuclear explosion: Seismol. Soc. America Bull., v. 59, no. 6, p. 2221-2230, illus., 1969.

The BENHAM underground nuclear explosion (1.1 megaton equivalent TNT) caused apparent release of natural tectonic strain at the Earth's surface in decreasing amounts out from the explosion point. Strain changes were measured on quadrilaterals about 1 km on a side at six different localities. Maximum extension of 521×10^{-6} was measured 1 km from the explosion and 33×10^{-6} was measured at 11 km. Maximum strain at each measured location, plotted against distance from the explosion, gave the equation $\log \epsilon = -3.2823 - 0.1087\ d$, where ϵ is strain and d is distance in km. Strain changes measured at $d > 5$ km appear to be fault controlled and are believed to result from release of tectonic strain. A level line across the explosion area showed fault-controlled subsidence of an area more than 3 km wide and probable slight uplift of the area to the east of that subsidence. — *from* Author's abstract

Dickinson, William R. *See* Swe, Win. 00029

06782 **Dietrich, James H.** Mathematical modeling of fault zone tectonics and seismicity [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 47-48, 1969.

06783 **Dietz, R. S.; Holden, J. C.; Sproll, W. P.** Geotectonic evolution and subsidence of Bahama platform [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 48, 1969.

06784 **Dollase, Wayne A.** Least-squares refinement of a plutonic nepheline and the problem of pseudocentrosymmetry [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 49, 1969.

Domenico, P. A. *See* Case, C. M. 06507

06529 **Donahue, Jack.** Genesis of oolite and pisolite grains — An energy index: Jour. Sed. Petrology, v. 39, no. 4, p. 1399-1411, illus., table, 1969.

Two mechanisms operate within caves to produce concentrically laminated calcareous grains; the splash cup produces grains under agitated conditions so that abrasion and carbonate precipitation take place. The second, the rimstone dam and pool concretion occurrences, produces grains under nonagitated conditions. Agitated grains show distinct, compact laminations which display a pseudo-uniaxial cross caused by oriented crystal structure and commonly have a nucleus, smooth polished surfaces, a low insoluble residue content, and approach a spheroidal shape. Nonagitated grains have indistinct, porous laminations lacking oriented crystal structure. They commonly lack nuclei, have rough surfaces, are high in insoluble residues, and develop irregular shapes. The Bahamian grains show characteristics of agitated grains whereas the West Texas Permian reef pisolites are quiescent in character. — *from* Author's abstract

06785 **Donnelly, Thomas W.** Precursors of island-arc systems [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 49-50, 1969.

06929 **Dorheim, Fred H.; Koch, Donald L.; Parker, Mary C.** The Yellow Spring Group of the Upper Devonian in Iowa: Iowa Geol. Survey Rept. Inv. 9, 30 p., illus., 1969.

A new group name, the Yellow Spring Group, is designated for those formations herein removed from the Kinderhook Series and assigned as the uppermost unit in the Upper Devonian Series. The formations comprising the Yellow Spring Group are, in descending order, the English River Formation, the Maple Mill Shale, the Aplington Formation and the Sheffield Formation. In spite of the gradational English River-Maple Mill contact in southeastern Iowa, and the local absence of English River and Maple Mill in north-central Iowa, these formations have significant lithologic features in common that justify their recognition as a rock-stratigraphic unit with group status. Recent work by paleontologists has resulted in raising the Devonian-Mississippian boundary from its previous position at the top of the Lime Creek to its presently designated position at the base of the North Hill Group. — Authors' abstract

06786 **Dort, Wakefield, Jr.** Geologic evidence of late-glacial recurrent climatic fluctuations, southeastern Idaho [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 50, 1969.

Douglas, R. G. *See* Heezen, B. C. 06736

Doyle, James A. *See* Gill, Harold E. 06747

06787 **Doyle, James A.** Angiosperm pollen evolution and biostratigraphy of the basal Cretaceous formations of Maryland, Delaware, and New Jersey [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 51, 1969.

06788 **Drafall, Larry E.; Koucky, Frank L.** Differential thermal analysis of the lead sulfantimonides [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 51-52, 1969.

06789 **Drake, David E.; Gorsline, Donn S.** Dispersal of suspended sediment off southern California during and following the 1969 winter floods [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 52, 1969.

06456 **Drake, John C.** Schreibersite and cohenite in Seymour [abs.]: Meteoritics, v. 4, no. 3, p. 166-167, 1969.

Drake, Robert. *See* Hay, R. L. 06730

06790 **Dreimanis, Aleksis.** Till wedges as indicators of direction of glacial movement [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 52-53, 1969.

06791 **Drever, James I.** Clay mineral formation and river water chemistry, Rio Ameca basin, Mexico [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 53, 1969.

00017 **Drewes, Harald.** Tertiary tectonics of the White Pine-Grant Range region, east-central Nevada, and some regional implications — Discussion [of paper by E. M. Moores, R. B. Scott, and W. W. Lumsden, 1968]: Geol. Soc. America Bull., v. 81, no. 1, p. 319-321, 1970.

In mapping of this region about 50 miles southwest of Ely, Nevada, Moores and others (ibid., v. 79, no. 12, p. 1703-1726, 1968) have concluded that almost all deformation of Paleozoic and Tertiary rocks was the result of a single orogenic epoch in late Tertiary. Drewes presents evidence to show that their conclusions are not consistent either with evidence from their own map or with widely accepted regional relations. — VSN

06946 **Driscoll, Egbert G.** A possible cricoconarid biocoenose from the Middle Devonian: Michigan Academician, v. 1, nos. 3-4, p. 135-139, illus., 1969.

Specimens discussed here were collected from lenses of argillaceous limestone of the Arkona Shale in float along a river bank near the town of Arkona, Ontario. The lenses consist of three layers: argillaceous lime tone on the bottom, covered by a shell hash with current-oriented *Tentaculites bellulus* the most common element, and a top layer identical to the bottom. In the latter, *Tentaculites* are numerous and occur in a vertical position with apical ends down, the first occurrence known oriented this way. It is possible that various taxa were adapted to a variety of living habits, and if a biocoenose assemblage is represented, generalization to other genera and species is not justified. Fisher (1962) concludes that a nektobenthonic existence with the apical end up is the most probable life habit. Uniformity of shell orientation in the upper layer of all available lenses leads to the conclusion that this is a biocoenose assemblage. — ESL

06959 **Driscoll, Egbert G.; Mitchell, Steven W.** Stratigraphy and tetracoral fauna of the lower Arkona Formation, Middle Devonian, Ontario and Michigan: Michigan Academician, v. 1, nos. 1-2, p. 117-141, illus., tables, 1969.

Fossil collections from glacial drift deposits near Arkona, Lambton County, Ontario, and well samples from Elgin, Kent, and Lambton Counties, Ontario, and Sanilac and St. Clair Counties, Michigan, indicate the presence of an undescribed Traverse fauna, stratigraphically below the "Arkona Shale" fauna. Species occurrence in both faunas are tabulated. Nomenclature and correlation of the upper and lower Arkona Formation are discussed and index fossils for each are listed. Systematic descriptions of the tetracorals are given; many are illustrated. — ESL

Druilhet, Aimé. *See* Guedelia, Daniel. 00072

06792 **Duane, David B.** Sand and gravel deposits in the nearshore continental shelf, Sandy Hook to Cape May, New Jersey [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 53-54, 1969.

06440 **Dudley, Priscilla P.** Electron microprobe analyses of garnet in glaucophane schists and associated eclogites: Am. Mineralogist, v. 54, nos. 7-8, p. 1139-1150, illus., tables, 1969.

Analyses of zoned garnet in 15 different rock types from the Franciscan assemblage of California are reported. Specimen localities include the Tiburon Peninsula, Occidental, Ward Creek near Cazadero, and Santa Catalina Island. Garnet in glaucophane schists from Shubin, U.S.S.R., and Loh oelo, Java is compositionally similar to Franciscan samples. Oscillatory zoning of garnet porphyroblasts is observed in rocks containing fine-grained monomineralic garnet bands. Comparison of microprobe analyses of the present study with conventional analyses of garnets from the same outcrops indicates that the latter are most representative of inclusion-free outer zones of individual crystals. Preliminary data for coexisting garnet, pyroxene and amphiboles shows similar fractionation of Mg and Fe in Franciscan eclogites and regionally metamorphosed glaucophane eclogites in the southern Urals. — Author's abstract

06457 **Duerr, J. S.; Ogilvie, R. E.** Microprobe analysis of carbon concentration in several iron meteorites [abs.]: Meteoritics, v. 4, no. 3, p. 169, 1969.

Dunlap, William J. *See* Scalf, Marion R. 06414

06454 **Dunning, G. E.; Cooper, J. F., Jr.** A second occurrence of antarcticite, from Bristol Dry Lake, California: Am. Mineralogist, v. 54, nos. 7-8, p. 1018-1025, table, 1969.

Antarcticite, $CaCl_2 \cdot 6H_2O$, occurs as divergent groups of colorless, prismatic crystals and compact aggregates in the exposed near-surface trapped brines, and is formed by natural solar concentration in the very arid climate. Associated minerals of the lake sediments include halite, gypsum, anhydrite, celesite, calcite, and chlorocalcite⅛?¼. The antarcticite is hexagonal with $a = 7.907$, $c = 3.95$ A, $c/a = 0.500$; $V = 214.02$ A^3. The strongest X-ray powder diffraction lines are listed. The mineral is colorless; fracture brittle; H = 2-3; density 1.700 g/cm^3; average specific gravity 1.715 ± 0.010; optically uniaxial; basal cleavage perfect; prismatic cleavage good to perfect. Chemical analysis, Ca 17.25, Mg 0.015, Si 0.003, Fe 0.003, Al 0.002, Na 0.30, Cl 33.14, H_2O 49.27. — *from* Authors' abstract

06793 **Eaton, J. P.; Lee, W. H. K.; Pakiser, L. C.; Roller, J. C.** Microearthquake mapping of active faults [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 54-55, 1969.

Ehlmann, Arthur J. *See* Brown, Thomas E. 06424

Ehrle, Elwood B. *See* Coleman, Babette B. 06679

Ehrlich, Robert. *See* Davis, Mary W. 06777

06794 **Elders, Wilfred A.** Zoned alkali feldspars from the Lincoln Sill syenite, Maine [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 55, 1969.

00062 **Ells, Garland D.** New oil strikes boost interest in Michigan: World Oil, v. 170, no. 1, p. 72-74, illus., 1970.

Three new gas and oil fields in northern Michigan have caused speculation that the area contains vast crude reserves. Evidence does not support this however. The new discoveries include the Onaway field in Presque Isle County, South Boardman field in Grand Traverse County, and Gaylord-Tecon Lake field in Otsego County, which are producing from Niagaran reefs of Silurian age and other types of porosity traps. These discoveries apparently refute early, misleading press claims that a "second" North Slope had been found. — GHD

06665 **Ellsworth, T. P.** In memoriam, Fredric Stephen Goerner [1915-1969]: Houston Geol. Soc. Bull., v. 12, no. 4, p. 22, 1969.

06795 **Elston, Wolfgang E.** Overplating — The role of mantle-derived juvenile volcanism in thickening the Earth's continental crust and in the evolution of small planetary bodies [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 55-56, 1969.

06962 **Emilia, D. A.; Bodvarsson, G.** Numerical methods in the direct interpretation of marine magnetic anomalies: Earth and Planetary Sci. Letters, v. 7, no. 2, p. 194-200, illus., 1969.

The direct determination of source rock magnetization on the basis of observed magnetic field values involves the numerical solution of a linear integral equation. This solution is obtained for a two-dimensional body of specified geometry and uniformly magnetized volume of elements by the Seidel iteration technique. Consideration of magnetic anomaly profiles associated with ocean floor spreading indicates that the magnetization values at the ridge crest are only slightly greater than those away from the crest. This, together with the evidence for narrow transition zones between sections of normal and reversed polarity, lends support to the dike injection mechanism for bringing mantle material to the surface at the ridge crest. — Authors' abstract

06796 **Emiliani, Cesare.** Amplitude of the Pleistocene climatic cycles at low latitudes and the oxygen isotopic composition of the ice caps [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 56-57, 1969.

06466 **Endersbee, L. A.** Man-initiated earthquakes,: Rock Mechanics, v. 1, nos. 2-3, p. 165-166, table, 1969.

Reported worldwide cases of seismic activity related to reservoir filling are tabulated with references and activities in the Denver, Colo., area possibly correlated with injection of waste fluids into a 3700 m deep borehole are examined briefly. In the latter injected fluid may have reduced the effective stress on a potential slip plane or reduced strength by changing surface energy, or both. Rothe attributes the seismic effects of reservoir filling to the load of mass of stored water; the most noticeable effects occur with reservoirs of maximum depth greater than 100 m. These man-initiated seismic shocks can supply important data for study of rock mechanics under earthquake conditions and should be reported. For engineers and geologists with no means for predicting seismic effects, the legal problems from possible law suits are frightening. — VSN

06586 **Engel, A. E. J.** Time and the Earth: Am. Scientist, v. 57, no. 4, p. 458-483, illus., table, 1969.

This is a semitechnical review of the concepts of time which men have held about the Earth, from the early beginnings of speculation to the present day rates of change now being witnessed. Ideas regarding the age of the Earth have changed appreciably since 1900, and a review of the relation of absolute to relative time is given. Examples of the relation between time, biology, and historical concepts are also given such as the recognition of changes in length of the year by study of coral development. Cyclical events, such as granitic events and their relation to postulated convective cells, are discussed. Present day rates of events can be shown by earthquake strain release and in-filling of the Caspian Sea. The history of the Earth and of man will continue to change enormously, episodically, and catastrophically with time. — HRC

07035 **Engineering-Science, Inc.** (compiler and editor). Annotated bibliography on hydrology and sedimentation, 1963-1965, United States and Canada: Joint Hydrology-Sedimentation Bull. 9, 527 p., 1969.

This bibliography was prepared under the auspices of the Hydrology and Sedimentation Committees, Water Resources Council, acting on behalf of several U.S. government agencies and departments. Annotations are given for listings unless the title is self-explanatory, or respondents did not supply abstracts, or publications containing missing papers were not available. The index covers both place and subject; in general, listings are primary only. — MCM

England, Anthony W. *See* Simmons, Gene. 06664

06797 **Enright, Richard C.; Isphording, Wayne C.; Lodding, William.** Paleoenvironment and diagenesis in marginal marine sediments of the New Jersey Tertiary [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 57, 1969.

Epp, D. *See* Ewing, M. 06748

Epstein, Anita G. *See* Epstein, Jack B. 06472

06472 **Epstein, Jack B.; Epstein, Anita G.** Geology of the Valley Ridge Province between Delaware Water Gap and Lehigh Gap, Pennsylvania, Field Trip 1-B *in* Geology of selected areas in New Jersey and eastern Pennsylvania and guidebook . . . —Geol.Soc.America, Ann.Mtg., Atlantic City, 1969: New Brunswick, N.J., Rutgers Univ. Press, p.132-205, illus., 1969.

Stratigraphy, structure, glacial geology, geomorphology and economic geology of Middle Ordovician through Middle Devonian rocks and surficial deposits in eastern Pennsylvania are interrelated. Pre-orogenic basin deepening resulted in thick Martinsburg flysch; from highlands of Taconic orogeny a thick Silurian wedge of clastics was deposited in a continental to marginal marine zone by rivers gradually lowered to coastal plain alluviation; then a cyclic infratidal to deep neritic complex developed into early Middle Devonian time. Four lithotectonic units are recognized, each unit deformed semi-independently and set off by décollements. Martinsburg slaty

cleavage is assigned to Appalachian orogeny. Erosion of the folded strata produced linear ridges and valleys; structurally controlled wind and water gaps affected travel and retreat of Pleistocene glaciers, their deposits now construction material resources. — GDC

06473 **Epstein, Jack B.** Structural control of wind gaps and water gaps and of stream capture in the Stroudsburg area, *in* Geology of selected areas in New Jersey and eastern Pennsylvania and guidebook. . .— Geol. Soc. America, Ann.Mtg., Atlantic City, 1969: New Brunswick, N.J., Rutgers Univ. Press, p.206-213, illus., reprinted 1969; originally published 1966.

This paper was published originally in U.S. Geol. Survey Prof. Paper 550-B, p. B80-B86, 1966. *See* Abstracts of North American Geology for November 1966. — MCM

Epstein, Samuel. *See* Taylor, Hugh P., Jr. 06569

06798 **Erdtmann, Bernd-D; Yzerdraat, Walter.** Graptolites — Biometrics and numerical taxonomy [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 58, 1969.

06799 **Ermanovics, I. F.** Flowage differentiation in monzonitic rocks of the Grenville Province of southeastern Ontario [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 58, 1969.

06800 **Ernst, W. G.** Tectonic contact between the Franciscan melange and the Great Valley sequence, a late Mesozoic Benioff zone [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 59, 1969.

Esai, Yi-Ben. *See* Aki, Keiiti. 06886

06925 **Espinosa, Alvaro F.** Ground amplification study at two sites near Bakersfield, California: Earthquake Notes, v. 40, no. 3, p. 3-20, illus., tables, 1969.

The spectral amplitude from 14 shallow-focus events in California and Nevada are used to determine the *ground amplification* in the $0.4<T<6.0$ sec. period range at two sites. The epicentral distances of these events range from 100 to 450 km, and their magnitudes $4.0<M_L<5.0$. The spectral amplitude ratios are formed for an event recorded by a low-gain Benioff system at two mobile stations, in order to determine quantitatively the effect of different subsoil conditions on the recorded signals from the two station locations. The statistical determination of the mean spectral ratios shows that the alluvium-to-granite ratios are higher than the sandstone-to-granite ratios by approximately one-half unit. It is also shown that these ratios vary as a function of frequency. — Author's abstract

06801 **Ettensoh, Frank R.** The influence of ground water access routes on concretionary development in proglacial lake sediments [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 59-60, 1969.

Eugster, Hans P. *See* Hardie, Lawrence. 06726

06447 **Evans, Bernard W.** Chlorine and fluorine in micas of pelitic schists from the sillimanite-orthoclase isograd, Maine: Am. Mineralogist, v. 54, nos. 7-8, p. 1209-1211, illus., table, 1969.

Coexisting muscovite and biotite averaged <0.01 and 0.03 percent Cl and 0.07 and 0.2 percent F, respectively by microprobe analysis. The F is partitioned regularly between biotite and muscovite. The amounts of halogens are too small to account for divariant behaviour of equilibria. — Author's abstract

06802 **Everett, John R.; Fakundiny, Robert H.** Post-Paleozoic tectonic history of the Comayagua Valley region, Honduras, Central America [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 60-61, 1969.

Ewing, J. I. *See* Ewing, M. 06748

06562 **Ewing, John I.; Houtz, R.** Mantle reflections in airgun-sonobuoy profiles: Jour. Geophys. Research, v. 74, no. 27, p. 6706-6709, illus., table, 1969.

Deep reflections have been recorded at sonobuoy stations where airguns were used as sound sources. Calculations show that the reflections are from interfaces at depths appropriate for the upper mantle. — Authors' abstract

06698 **Ewing, K.; Loomis, S.; Lougeay, R.** Water-spout on Kaskawulsh Glacier, *in* Icefield Ranges Research Project scientific results, V. 1 (V. C. Bushnell and R. H. Ragle, editors): New York, Am. Geog. Soc., and Montreal, Quebec, Arctic Inst. North America, p. 147-148, illus., 1969.

In June 1966 a vertical spout of water rose suddenly from the Kaskawulsh Glacier surface in the same area where Dewart (ibid., p. 145-146) observed several moulins; the spout lasted 7-10 sec and reached a maximum height of 4-5 m. The only sound was the noise of rushing water; there was no sharp sound of fracturing ice. Immediate investigation revealed the water had issued from a vertical fissure 7-8 cm wide and oriented perpendicular to glacier flow; in cross section the fountain of water was tabular rather than columnar. Water from surrounding slush areas began to flow into the fissure almost immediately; within two days it was apparent that a distinct circular moulin was developing. About a month later the moulin had a diameter of about 1.25 m, and there was an irregular pulsation of air from the mouth carrying aloft a fine spray of water. — MCM

06748 **Ewing, M.; Aitken, T.; Epp, D.; Ewing, J. I.; Hayes, D. E.; Pitman, W. C.; Renard, V.; Talwani, M.; Worzel, J. L.** Lamont-Doherty marine surveys of the Atlantic drill sites of the Joides Deep Sea Drilling Project [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 61, 1969.

06948 **Ewoldsen, H. M.; McNiven, H. D.** Rockbolting of tunnels for structural support — Pt. 2, Design of rockbolt systems: Internat. Jour. Rock Mechanics and Mining Sci., v. 6, no. 5, p. 483-497, illus., 1969.

The design of rockbolt systems to remove the possibility of major failure of the rock surrounding the tunnel is discussed. Without rock bolting, tension failure is likely for several cases of historical stress. One of these cases is chosen for a numerical example, and a design is formulated which will remove possibility of failure. Tangential compression is found to be high at the sides of the tunnel about midheight, and a design is presented to prevent compression failure. Possibilities of slip failure along preferential planes is studied. Since with such planes the material would be transversely isotropic rather than isotropic, regions around the tunnel are located where slip is likely, based on stress field surrounding a tunnel in isotropic material. Designs of rockbolt systems are presented to remove possibilities of major failure due to slip. — *from* Authors' abstract

Ewoldsen, H. M. *See* McNiven, H. D. 06949

Fahlquist, Davis A. *See* Pyle, Thomas E. 06539

06552 **Fahnestock, Robert K.** Morphology of the Slims River, *in* Icefield Ranges Research Project scientific results, V. 1 (V. C. Bushnell and R. H. Ragle, editors): New York, Am. Geog. Soc., and Montreal, Quebec, Arctic Inst. North America, p. 161-172, illus., tables, 1969.

On the basis of discharge measurements and observations of gage height and flow phenomena, discharge of Slims River ranged from 0-20,000 ft^3/sec. The stream was regrading the three zones of the valley train; the slope was gradually being adjusted to changes in load and discharge and to channel form existing in each zone. Evidence supports postglacial drainage reversal suggested by Bostock for the Slims system from the Kaskawulsh-Alsek River to the Yukon River. In 1967, however, the Kaskawulsh Glacier's contribution to the Slims River shifted subglacially to the Kashawulsh River, imposing a new set of conditions on the valley train and Kluane Lake. Initial changes due to this shift include a major decrease in discharge of Slims River and an increase in amount of blowing sediment. — *from* Author's abstract

06820 **Fahnestock, Robert K.; Bradley, William C.; Leveen, Larry S.** Bed forms and flow phenomena during a Lake George breakout flood, Knik River, Alaska [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 61-62, 1969.

06669 **Fajardo, Ivan.** Abnormal pressures, connate waters and shale mineralogy in southwestern Louisiana [abs.]: Corpus Christi Geol. Soc. Bull., v. 10, no. 3, p. 2, 1969.

Fakundiny, Robert H. *See* Everett, John R. 06802

06821 **Fang, J. H.; Robinson, Paul D.** The crystal structure of coquimbite [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 63, 1969.

06691 **Farquharson, R. B.; Stipp, J. J.** Potassium-argon ages of dolerite plugs in the South Cariboo region, British Columbia: Canadian Jour. Earth Sci., v. 6, no. 6, p. 1468-1470, illus., table, 1969.

Potassium-argon dates for late Tertiary dolerite plugs in south-central British Columbia indicate that a period of volcanism occurred in mid-Pliocene time. — Authors' abstract

Farvolden, Robert N. *See* Hughes, George M. 07019

Faure, G. *See* Fenton, M. D. 06823

06468 **Fay, Robert O.; Graffham, A. Allen.** Bromide Formation on Tulip Creek and in the Arbuckle Mountains region, *in* Regional geology of the Arbuckle Mountains, Oklahoma: Oklahoma Geol. Survey Guidebook 17, p. 37-39, illus., 1969.

A generalized measured section of the Bromide Formation, the uppermost of the five formations of the Simpson Group, indicates it is 420 feet thick. The Bromide is subdivided into two members, the Pooleville Limestone (upper 120 feet) and the Mountain Lake Shale (lower 300 feet) with large amounts of sandstone in the lower 100 feet. Regionally the Bromide has considerable sandstone to the north, shale to the west and south, and limestone to the east; it is thinner eastward and northeastward, along with other formations of the Simpson Group, and appears to be thinner southward in the Criner Hills. — HRC

06973 **Feldmann, Rodney M.; Holland, F. D., Jr.** Coccoliths from the Niobrara Formation (Upper Cretaceous) of northeastern North Dakota: North Dakota Acad. Sci. Proc. 1968, v. 22, p. 104-110, illus., 1969.

During a study of the literature dealing with fossil and recent nannoplankton, it became apparent that they should occur in Mesozoic marine sedimentary rocks in North Dakota. A sample of calcareous shale from the Niobrara was prepared, and confirmed the suspicion. Occurrence of the coccoliths is discussed, and a list of genera collected and identified so far is presented. A simple method of preparing slides is described, and future problems related to study of coccoliths of the midcontinent Cretaceous are suggested. — ESL

06822 **Felsher, Murray.** The Santa Cruz canyon system, continental borderland, California — Bathymetry and textural analyses of the cores [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 63-64, 1969.

06823 **Fenton, M. D.; Faure, G.** The isotopic evolution of terrestrial strontium [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 64, 1969.

06597 **Fertl, W. H.** Delaware Gradient — True or false: Log Analyst, v. 10, no. 6, p. 44, illus., 1969.

Laterlog readings immediately below a thick highly resistive section can have a fairly high error. Resistivity values will be too high for a distance of about 80 feet with a decreasing gradient, which is present when the potential of the reference electrode becomes negative. The figure shows an apparent Delaware gradient in a gas pay sec-

tion with a water contact in a Permian formation, a sandstone with shale intercalations; a highly resistive evaporite lies above the pay sand. The section has an average porosity of 18 percent with permeabilities up to 1000 millidarcies; therefore the Delaware gradient is suspect. But experience in the area has shown that the gradient decrease of resistivity from the evaporite to the sandstone is commonplace. In this example both the laterlog and microlaterlog show quite a similar gradient. — GDC

06824 **Field, Michael E.; Pilkey, Orrin H.** Source and transportation of sediments on the Carolina continental rise [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 64-65, 1969.

Fischer, A. G. *See* Heezen, B. C. 06736

07012 **Fischer, A. G.; Gealy, Elizabeth L.** Summary and comparison of lithology and sedimentary sequence in northwest Atlantic and northwest Pacific [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 65, 1969.

06803 **Fischer, William A.** EROS the *E*arth *R*esources *O*bservation *S*atellite program of the Department of the Interior [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 65-66, 1969.

06804 **Fisher, Donald W.** Quinquallochthonous succession and a new molasse in the southern Hudson Valley and their bearing on New York tectonic history [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 66, 1969.

06667 **Fisher, W. L.** Eocene depositional systems of the Gulf Coast Basin — Their relation to oil and gas [abs.]: Houston Geol. Soc. Bull., v. 12, no. 4, p. 19-20, 1969.

Fisher, William L. *See* Flawn, Peter T. 06805

Fitch, Thomas J. *See* Boucher, Gary. 06567

Fitch, Thomas J. *See* Scholz, C. H. 06568

Fitton, J. A. *See* Lee, K. L. 06378

06805 **Flawn, Peter T.; Fisher, William L.; Brown, L. Frank.** Environmental geology and the coast — Rationale for land-use planning [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 67, 1969.

06806 **Fleischer, Peter.** Mineralogy of Holocene basin sediments, California continental borderland [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 67-68, 1969.

06512 **Flemal, Ronald C.** Iron-bearing heavy minerals in the Sespe Formation (California): Jour. Sed. Petrology, v. 39, no. 4, p. 1616-1618, illus., 1969.

The original detrital iron-bearing minerals of the Sespe Formation have been altered to a hematite-leucoxene suite. Most of this alteration must have occurred after deposition and some iron mobility may still be present. — Author's abstract

06807 **Folinsbee, R. Allin; Biehler, Shawn; Bowin, Carl O.** Gravity anomalies and crustal structure of Trinidad [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 68, 1969.

Fontan, Jacques. *See* Guedelia, Daniel. 00072

06426 **Forgotson, James M., Jr.** Factors controlling occurrence of Morrow sandstones and their relation to production in the Anadarko basin: Shale Shaker, v. 20, no. 2, p. 24-38, illus., 1969.

Data from 1,200 wells in the Panhandle of Texas and Oklahoma and 600 wells in northwestern Oklahoma were processed by computer. Isopach and facies maps,

prepared for three subdivisions of the Morrow in the Panhandle area and for seven units of the lower Morrow in northwestern Oklahoma, were used with stratigraphy based on electric-log correlations to interpret depositional history and predict favorable areas for development of porous sandstones. The Morrow is the basal transgressive clastic unit of the Pennsylvanian, thickness correlating closely with residual structure on the Mississippian. Early Pennsylvanian structural movement continued through Morrow deposition. Widespread sandstones paralleling shorelines were deposited as the sea overlapped the shelf; lenticular bodies were deposited by a complex stream system. Oil and gas production is primarily stratigraphically controlled. — ESL

06450 **Forneris, Roberto.** The infrared and Raman spectra of realgar and orpiment: Am. Mineralogist, v. 54, nos. 7-8, p. 1062-1074, illus., tables, 1969.

Far infrared absorption and laser-excited Raman spectroscopy can be easily applied to the investigation of minerals and are extremely useful for structural studies and identification purposes, especially for crystals containing heavier atoms. It is only necessary to have the crystals ground to a powder. The powder is used directly to obtain Raman spectra and as an ordinary mull for the far infrared. If a single crystal or a cluster of small crystals is available, a Raman spectrum can be obtained without any preparation at all. These points are exemplified by the spectra of As_4S_4 (realgar) and As_2S_3 (orpiment). The observed spectrum of realgar is tentatively assigned to an As_4S_4 molecule of the cradle type, possessing D_{2d} symmetry. The As-S stretching and S-As-S bending regions are identified for orpiment. — Author's abstract

Foster, W. R. *See* Lin, H. C. 06678

06808 **Fournier, Robert O.; Bird, Derwood B.** The effect of low steam pressure upon the base exchange of Na+ and K+ between solution and alkali feldspar at high temperatures [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 69, 1969.

06809 **Fox, P. J.; Schreiber, E.; Heezen, B. C.** Igneous rocks and Tertiary sediments from the Aves Ridge [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 69-70, 1969.

06433 **Fox, Steven K., Jr.; Olsson, Richard K.** Danian planktonic foraminifera from the Cannonball Formation in North Dakota: Jour. Paleontology, v. 43, no. 6, p. 1397-1404, illus., table, 1969.

Planktonic foraminifera occur sporadically throughout 395 feet of the Cannonball Formation at Garrison Dam, N. Dak. The assemblage (7 species, none new) is characteristic of the *Globigerina edita* Zone of Hillebrandt, 1965 (=*Globorotalia pseudobulloides* Zone of Bolli, 1966) and is considered diagnostic of the lower parts of the Danian stage (below the *Globorotalia trinidadensis* Zone). This precise correlation of the Cannonball indicates a similar age for equivalent nonmarine formations in Montana, Wyoming, and the Dakotas (Ludlow, Tullock). The Ludlow in North and South Dakota has been dated as Paleocene on plant, spore, and pollen evidence. The Tullock in Wyoming contains Paleocene plants. Recently the Tullock in eastern Montana has yielded Paleocene mammals of the Puercan stage. — *from* Authors' abstract

Franklin, A. G. *See* Krizek, R. J. 06484

Franklin, A. G. *See* Krizek, R. J. 06485

06532 **Franks, Paul C.** Nature, origin, and significance of cone-in-cone structures in the Kiowa Formation (Early Cretaceous), north-central Kansas: Jour. Sed. Petrology, v. 39, no. 4, p. 1438-1454, illus., table, 1969.

The cone structures are of two types: those in concretions and calcite-cemented sandstone, composed of plumose aggregates of fibrous calcite, and those in lenses of cone-in-cone, composed of microgranular calcite. Origin of the first is due to the growth and precipitation of fibrous calcite during early diagenesis, and the microgranular texture is due to the recrystallization of the fibrous calcite by diagene-

sis. Recrystallization probably was induced by anaerobic decay of organic material in underlying fossiliferous strata. The consistent association of calcite, marcasite, and carbonaceous debris in the cone-in-cone implies a unique set of physico-chemical conditions while the sediments were still plastic. The diagenetic environment contrasts with that in which concretions of impure siderite grew, chiefly in the availability of Ca ion and reduced sulfur. — *from* Author's abstract

06989 **Frerichs, William E.** Scanning electron microscope analysis of the homeomorphs *Melonis pompilioides* and *Melonis soldani*: Wyoming Univ. Contr. Geology, v. 8, no. 1, p. 43-45, illus., 1969.

Melonis pompilioides is generally recognized as a reliable deep-water indicator of Neogene sediments of the world. In foraminiferal assemblages of the eastern hemisphere, however, from Neogene sections which apparently are shelf or upper bathyal deposits, a Pleistocene specimen identified by DiGrande (1967) as *M. pompilioides* should be, on closer inspection, referred to *M. soldani* (d'Orbigny), a shallow-water homeomorph. Photographs of tests of the two specimens taken with a scanning electron microscope suggest specific differences which are not always clearly defined in illustrations; differences in pore size, sutural relief, and relation of the umbilicus and sutures are discussed. Application of these criteria will allow more precise identification. Evolutionary considerations appear to be negligible. — GDC

Frey, Robert W. *See* Hattin, Donald E. 06436

06810 **Frey, Robert W.** Mixed benthic assemblages in Holocene clays, Cabretta Island beach, Georgia [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 71, 1969.

Friedman, Gerald M. *See* Baker, Seymour R. 06494

Friedman, Gerald M. *See* Haglund, David S. 06538

00069 **Friedman, M.; Logan, J. M.** Influence of residual elastic strain on the orientation of experimental fractures in three quartzose sandstones: Jour. Geophys. Research, v. 75, no. 2, p. 387-405, illus., tables, 1970.

The three-dimensional state of elastic strain was measured by X-ray diffractometry in three quartzose sandstones. A prediction was then made of the orientations of fractures that would be induced in each rock by loading normal to bedding. It was found that: tensile fractures induced by unconfined point-loading are preferentially oriented relative to certain directions within the bedding planes; preferred orientations of shear fractures persist under high confining pressure; most fabric elements are randomly oriented and can be eliminated as possible sources of anisotropies that might control orientations of fractures; and as the state of prestrain can influence orientations of shear fractures even under high confining pressure, this influence may be felt at depths of several thousand feet in the crust. The latter should be accounted for in rock mechanics applications involving fracture. — DBV

Frishman, S. A. *See* Behrens, E. W. 06840

06811 **Frishman, Steven A.; Behrens, E. William.** Geochemistry of oolites, Baffin Bay, Texas [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 71, 1969.

06812 **Fry, Harold C., Jr.** Individualized instruction in earth science — A workable theory [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 72, 1969.

06386 **Fry, Willis E.** A paleontological site survey conducted in the Horse Heaven Hills of south-central Washington: Northwest Sci., v. 43, no. 4, p. 156-161, illus., tables, 1969.

Exploration in an area of the Horse Heaven Hills south of Kennewick, Benton County, Wash., revealed 31 sites yielding vertebrate fossil fragments. Mammoth was identified at 21 sites, bison at five, horse at three; deer and other remains, some not

identified, were also found; no attempt has been made to classify the animals as to species. Most of the fossils were found in canyon exposures of cemented eolian silt, in which intercalated volcanic ash beds apparently represent the 6,700-6,900 yr old Mt. Mazama and 12,000-13,000 yr old Glacier Peak eruptions. Most of the fossils are between 7,000 and 12,000 years old, but some were found below the Glacier Peak ash. Projectile points, one possibly as old as 13,000 years, were all surface finds and so cannot be related directly to the animal remains; detailed excavation may reveal such relations. — VMJ

Fulkerson, Frank B. *See* Stroud, Raymond B. 06672

06813 **Fullagar, Paul D.; Bottino, Michael L.** Sulfide mineralization and anomalous Rb-Sr whole-rock ages [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 72-73, 1969.

06814 **Funk, John L.** Open crack initiation and propagation in rock, based on photoelastic coating studies [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 73, 1969.

06587 **Furlow, James W.** Stratigraphy and economic geology of the eastern Chatham County phosphate deposit: Georgia Geol. Survey Bull. 82, 40 p., illus., 1969.

This study, refining Tertiary stratigraphy, indicates that the Miocene confining layer (Hawthorne Formation) above Savannah's artesian aquifer is thick and impervious enough to allow removal of the phosphate ore zone (mostly in Duplin Marl) without significant salt-water infiltration into the aquifer, in this Georgia area north of Ossabaw Sound. The Pleistocene overburden thickness varies from 70 feet under Savannah Beach to 130 feet under Ossabaw Sound; the phosphate matrix varies in thickness from 15 feet under the mouth of the Savannah River to 50 to 60 feet under Skidaway Island. Recoverable phosphate approximates 4,800,000,000 cu yd of matrix, averaging 22.5 percent bone phosphate of lime or about 1.6 billion tons of pure BPL concentrate, at least half of which could be marketed. Evidence indicates that the phosphate matrix may extend out to sea for at least ten miles. — GDC

Furrer, Max A. *See* Bryant, William R. 07033

06931 **Gabrysch, R. K.; Naftel, W. L.; McAdoo, Gene.** Records of water-level measurements in observation wells in Harris County, Texas: Texas Water Devel. Board Rept. 103, 253 p., illus., tables, 1969.

Water-level measurements in most observation wells in Harris County are made annually, but some are made monthly, quarterly, or semiannually. Tabulated data include well number, completion depth interval, depth of well, elevation of land surface, date of measurement, and depth to water. A map shows location of observation wells. — MCM

06815 **Gaffney, Edward S.; Ahrens, Thomas J.** Covalent energies in partially ionic crystals [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 73-74, 1969.

06590 **Galanopoulos, A. G.; Bacon, Edward.** Atlantis — The truth behind the legend: Indianapolis, Ind., and New York, Bobbs-Merrill Co., 216 p., illus., 1969.

Since what is essentially new in this book derives from the work of a seismologist concerned mainly with earthquake and volcanic processes, the approach and solution are geophysical. Sections are: what Plato meant and said — cultural aspects, geography, and dating of Plato's Atlantis; where was Atlantis, old theories demolished — Atlantic Ocean and other sites; geophysical theories and facts — geophysical and archeological aspects, Aegeis and Santorin, volcanic history of Santorin; and case proven — ancient metropolis and royal city. An epilogue stresses the geological basis for the suggested solution. One appendix contains excerpts from Plato's writings, another examines evidence or traditions of other perhaps contemporary disasters which can also be explained as byproducts of the Santorin explosion. A bibliography, notes on illustrations, and an index are included. — MCM

06816 **Galvin, Cyril J., Jr.; Hayes, Miles O.** Winter beach profiles and wave climate [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 74-75, 1969.

Gardner, G. H. F. *See* Barbish, A. B. 06866

Gardner, J. *See* Sheridan, R. E. 06497

06684 **Gardner, J.** Observations of surficial talus movement [with German and French abs.]: Zeitschr. Geomorphologie, new ser., v. 13, no. 3, p. 317-323, illus., table, 1969.

Quantitative data illustrate the amount and type of transport on the slope surface of talus forms in the Lake Louise district of the Canadian Rocky Mountains. The absolute amount of movement between July 1965 and July 1967 was greater and the pattern more irregular in a spatial sense than was anticipated. The record of the talus shift on nine test slopes is tabulated; on the more active slopes where marked stones became buried, recovery rates were as low as 50 percent, elsewhere 100 percent. Maximum shift of individual particles varied greatly between transects and between slopes. Movement was not restricted to the center of slopes but also occurred at slope margins; rate of talus shift was greater towards the top than the base of the talus. Considerable variations in rate and amount of shift occurred between adjacent and apparently identical features in short-term periods. Isolated forces are indicated. — GDC

06410 **Gardner, Jim.** Snowpatches — Their influence on mountain wall temperatures and the geomorphic implications: Geog. Annaler, v. 51A, no. 3, p. 114-120, illus., 1969.

Temperature data from two snowpatches in the Canadian Rocky Mountains are presented and discussed with respect to their geomorphological significance. While the data represent the summer period only, they show that the presence of snowpatches influences mountain wall temperature conditions to the extent that diurnal freezing and thawing occurs occasionally. Shattered bedrock on the mountain walls indicates that active physical weathering has occurred. An under-cutting or notch at the break in slope between the mountain wall and a talus accumulation indicates that the weathering is most concentrated in this location. This break in slope is often the site of late-lying snowpatches. The shattered bedrock, the notch and the temperature data suggest that the presence of snowpatches is of considerable geomorphic significance in the high mountain environment. — Author's abstract

06817 **Gardner, William I.** Seismic events related to newly built reservoirs [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 75-76, 1969.

Garrison, R. E. *See* Heezen, B. C. 06736

06818 **Gartner, Stefan, Jr.; Cita, Maria B.; Nigrini, Catherine.** The oldest sediments across the North Atlantic [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 76, 1969.

06558 **Gault, Donald E.; Wedeking, John A.** The destruction of tektites by micrometeoroid impact: Jour. Geophys. Research, v. 74, no. 27, p. 6780-6794, illus., tables, 1969.

Damage to tektites by collisions with micrometeoroids has been studied by firing small projectiles at high speed against glass spheres. Projectile kinetic energies per unit mass of the spheres less than 10^6 ergs per g produce craters on the surface of the sphere while energies greater than 10^7 ergs per g cause complete rupture of the sphere into small fragments. These results, combined with estimated of micrometeoroid flux, at 1 AU, indicate that mean survival time before complete destruction of tektites in circular heliocentric orbits is of the order of 10^3 and 10^4 yr for objects 1 to 10 cm in diameter; partial fragmentation and loss of physical identity as tektites occurs in much shorter periods of time. Any tektites ejected from the Moon that initially miss the Earth and pass on into interplanetary space do not provide a source of recognizable tektite bodies which the Earth could subsequently sweep up over extended time periods. — GV

06557 **Gavasci, A. T.; Helmstaedt, H.** A pyroxene-rich garnet-peridotite inclusion in an ultramafic breccia dike at Moses Rock, southeastern Utah: Jour. Geophys. Research, v. 74, no. 27, p. 6691-6695, illus., table, 1969.

A medium-grained rock composed of clinopyroxene, garnet, and olivine, apparently not previously found in the Colorado Plateau diatremes, was recently discovered at the Moses Rock dike, San Juan County, Utah. The occurrence of this mineral assemblage is of importance in the light of recent discussions proposing that dense xenoliths of these diatremes represent possible fragments of the upper mantle. — Authors' abstract

Gealy, Elizabeth L. *See* Fischer, A. G. 07012

06876 **Gelnett, Ronald.** The San Francisco Bay and Delta Model, Field Trip 6 *in* 1969 field trips — Assoc. Eng. Geologists, Natl. Mtg., San Francisco, Calif., 1969: [Berkeley, Calif.] Assoc. Eng. Geologists, p. F1, 1969.

The San Francisco Bay and Delta Model, in Sausalito, Calif., is a hydraulic model used to analyze problems that cannot be resolved through the use of existing knowledge, experience, or mathematical treatment alone. The model reproduces, on a horizontal scale of 1 in. = 1000 ft and vertical scale of 1 in. = 100 ft, the tides, salinity, current velocities and direction, and shoaling in the Bay. Current and future studies will be on environmental quality as affected by fill, pollution, and fresh-water flows, pollutant dispersion from all drainage areas, and methods to alleviate problems of salt water introduction in the Delta. — DBV

06668 **Gerdel, Robert W.** Characteristics of the cold regions — Cold Regions Science and Engineering Monograph I-A: Hanover, N. H., U.S. Army Corps Engineers, Cold Regions Research and Eng. Lab., 53 p., illus., tables, 1969.

This monograph gives a brief introduction to total cold environments preparatory to the more detailed treatments of the later works in the series "Cold Regions Science and Engineering." Subjects discussed are: temperature; snow; glaze, rime, and hoarfrost; ice (glaciers; lake, river,sea ice); frozen ground; and atmospheric phenomena. — ESL

06819 **Gernant, Robert E.** Paleoenvironments of the Miocene Choptank Formation [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 76-77, 1969.

06441 **Giardini, A. A.; Salotti, C. A.** Kinetics and relations in the calcite-hydrogen reaction and relations in the dolomite-hydrogen and siderite-hydrogen systems: Am. Mineralogist, v. 54, nos. 7-8, p. 1151-1172, illus., tables, 1969.

Reactions of calcite, dolomite, and siderite with hydrogen at elevated temperatures and pressures result in the formation of inorganic hydrocarbons up to and including butane. The carbonate-hydrogen experiments were run in a "cold-seal" type vessel. The analyses of the reaction products were done by mass spectrometry for the gases, and by wet chemical, atomic absorption spectroscopy, and X-ray methods for the solids. Hydrocarbons appear to form directly from a carbonate surface-gas reaction rather than from a reaction between generated gas and hydrogen. An inverse relation holds between the complexity of the hydrocarbon formed and the temperature of formation. An evaluation of the kinetic data for calcite-hydrogen shows the reaction to be pseudo-first-order. For the experimental system the Arrhenius apparent activation energy is 18,000 cal/mole. — Authors' abstract

07013 **Gibbons, John F.; Schloffman, Steven.** Residual stresses in spheroidally weathered boulders [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 77, 1969.

Gibbs, G. V. *See* Brown, G. E. 07029

Gibson, Shirley M. *See* Shaw, Denis M. 06689

Gibson, Thomas G. *See* Buzas, Martin A. 06864

06513 **Gifford, John A.** A hydraulic corer for use in water saturated sediment: Jour. Sed. Petrology, v. 39, no. 4, p. 1619-1621, illus., 1969.

A suction corer utilizing an expendable plastic core liner was developed to sample sand strata in the tidal-flat environment. The device is lightweight, simple to operate, and contains a minimum number of moving parts. With it, continuous cores up to 10 feet in length and retaining sediment interstitial water, were obtained. — Author's abstract

06704 **Gigl, Paul D.; Dachille, Frank.** P-T studies in the alumina-water system [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 77, 1969.

06744 **Gill, Dan.** A computer oriented method for the zonation of ordered data sets and its application to reservoir evaluation and digitized log analysis [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 78, 1969.

06745 **Gill, Harold E.** Hydrologic significance of confining layers in the artesian Potomac-Raritan-Magothy aquifer system in New Jersey [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 78-79, 1969.

06747 **Gill, Harold E.; Sirkin, Leslie; Doyle, James A.** Cretaceous deltas in the New Jersey coastal plain [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 79, 1969.

Gittins, J. *See* Macintyre, R. M. 06952

06705 **Glass, Billy P.** Comparison of the chemical variation in a flanged australite with the chemical variation among "normal" Australasian microtektites [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 80, 1969.

Glen, J. W. *See* Jones, S. J. 06905

06706 **Goldich, S. S.; Mudrey, M. G., Jr.** Dilatancy model for discordant U-Pb zircon ages [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 80, 1969.

Goldthwait, Richard P. *See* Borns, Harold W., Jr. 06554

06662 **Goode, Harry D.** Reconnaissance appraisal of the water resources near Escalante, Garfield County, Utah: Utah Geol. and Mineralog. Survey Water-Resources Bull. 11, 38 p., illus., tables, 1969.

To irrigate about 5,000 acres of arable land now uncultivated in the Escalante area, and because surface waters are essentially appropriated, it is recommended that test wells be drilled to the Entrada (base about 600 feet deep) and/or Navajo Sandstones (top about 1,000 feet deep) to determine their potential. Both are porous enough to be good aquifers and are in favorable geologic positions for producing water. If the Navajo is saturated throughout its 1,500 feet thickness, 50,000 to 60,000 acre-feet per sq mi are estimated in storage and probably under artesian pressure. Development of either or both these probable aquifers could yield the desired 15,000 acre-feet of water from perhaps twenty 20-in wells. Water quality is good, except in the Carmel Formation which lies between the Navajo and Entrada. — *from* Author's abstract

06707 **Goodell, Philip C.; Petersen, Ulrich.** Hydrothermal differentiation — [Pt.] 1, Metal ratio studies [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 80-81, 1969; Econ. Geology, v. 64, no. 7, p. 834-835, 1969.

06708 **Goodell, Philip C.** Hydrothermal differentiation — [Pt.] 2, Sulfide normative calculations [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 81, 1969; Econ. Geology, v. 64, no. 7, p. 835, 1969.

00056 **Goodman, Richard E.; Taylor, Robert L.; Brekke, Tor L.** A model for the mechanics of jointed rock — Closure [to discussion of paper 5937, 1968]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM 1, p. 298, 1970.

In reply to discussions of their paper [ibid., v. 94, no. SM 3, p. 637-659, 1968], the authors state that mathematically based methods of describing rock behavior are not only appropriate to use but extremely powerful. Vasilescu's pessimism may be justified where there are relatively few engineering dollars per cubic yard of excavation. The advantage of a mathematical model is that it enables the extreme cases to be studied. — ESL

06709 **Goodwin, Jonathan H.; Parker, Ronald B.; Surdam, Ronald C.** Authigenic silicates in the Tipton Member of the Green River Formation, Wyoming [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 81-82, 1969.

00063 **Gordon, Robert B.** Mechanical properties of iron meteorites and the structure of their parent planets: Jour. Geophys. Research, v. 75, no. 2, p. 439-447, illus., 1970.

The strength and ductility of metal from the meteorite Gibeon have been determined over a range of temperatures and strain rates. The room temperature yield strength is 3.2 kb and the elongation at fracture, 19 percent; these quantities are much less sensitive to temperature and strain rate in the Gibeon metal than in pure iron. There is no evidence of embrittlement of the metal in Gibeon by nonmetallic inclusions. The absence of structural evidence of ductile fracturing strongly suggests that the Gibeon irons are not fragments of some larger metal mass, such as a planetary core, but existed as separate metal pieces surrounded by stony material in the parent planet. The available evidence indicates that a similar conclusion probably can be drawn for most iron meteorites. — Author's abstract

06710 **Gordon, Terence M.** The stability of grossularite in H_2O-CO_2 mixtures [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 82, 1969.

Gorsline, Donn S. *See* Drake, David E. 06789

07046 **Gould, Stephen Jay.** An evolutionary microcosm — Pleistocene and Recent history of the land snail *P.* (*Poecilozonites*) in Bermuda: Harvard Univ. Mus. Comp. Zoology Bull., v. 138, no. 7, p. 407-531, illus., tables, 1969.

Adaptive radiation of the endemic pulmonate land snail *P.* (*Poecilozonites*) is analyzed using multivariate biometry. Ontogeny is characterized by complex allometric trends. The species *cupula*, *bermudensis*, and the sympatric *nelsoni* and *superior*, n. sp., occur in earliest Pleistocene strata and gave rise to subspecies adapted to fluctuating climate and sea level, recorded in the Bermuda section as alternating glacial red soils and marine and eolian carbonates. The five subspecies of *cupula* (2 new) are distinguished chiefly by correlated color and size differences. During 300,000 years, the central stock of *bermudensis*, *P. b. zonatus*, gave rise successively to four paedomorphic thin-shelled subspecies, three new and the only living form, in adaptation to the low calcium environment of red soils. The sympatric species also developed a thick-shelled eolianite and a thin-shelled red-soil subspecies. — VMJ

Graffham, A. Allen. *See* Fay, Robert O. 06468

Gram, Ralph. *See* Warnke, Detlef A. 06509

06878 **Grant, Willard H.** Abrasion pH, an index of chemical weathering [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 17, no. 3, p. 151-155, illus., 1969.

If a series of rock samples with granitic composition in various stages of chemical weathering is ground in a mortar with distilled water and the pH of the slurry produced is determined, it will be evident that the pH declines as the weathering increases. This relationship can be made useful by plotting abrasion pH against some other index of weathering such as the percentage of clay mineral or the bulk density of the weathered rock. Factors controlling abrasion pH are the cations such as K, Na, Ca, and Mg and the amount of clay mineral present. — Author's abstract

Grasty, Robert. *See* Milton, Charles. 07031

06508 **Gray, N. H.** Grain size-frequency distributions from thin-section data: Jour. Sed. Petrology, v. 39, no. 4, p. 1598-1599, table, 1969.

A general mathematical technique for determining the true size-frequency of particles of known shape from their thin-section size frequency distribution is developed. — Author's abstract

Gregg, Robert Q. *See* Borst, Roger L. 07018

06711 **Greiner, Gary O. G.** Evolutionary development of major foraminiferal groups [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 82-83, 1969.

00041 **Gresens, Randall L.** Serpentinites, blueschists, and tectonic continental margins: Geol. Soc. America Bull., v. 81, no. 1, p. 307-310, 1970.

A recently proposed model for metastable production of blueschists during serpentinization has broad implications for processes taking place at tectonic continental borders. This paper accepts current ideas on continental underthrusting by the seafloor spreading mechanism and examines the following problems associated with the Franciscan Formation: (1) presence of amphibolites; (2) detrital serpentine and glaucophane; (3) origin of alpine ultramafic rocks; and (4) time relationships of sedimentation and metamorphism. The metastable formation of blueschists at relatively shallow depths is more compatible with these observations than the deep burial required by conventional facies treatment of metamorphism. — Author's abstract

Gresens, Randall L. *See* Bockheim, James G. 06385

06968 **Gresens, Randall L.** Bluechist alteration during serpentinization: Contr. Mineralogy and Petrology, v. 24, no. 2, p. 93-113, illus., table, 1969.

A model for blueschist alteration during serpentinization is presented in which the reaction path rather than the thermodynamically lowest energy state is considered to be a controlling factor. The iron in the ultramafic rock is oxidized, and pore water in the surrounding rocks becomes reducing. The pore fluids react with the surrounding rocks by a reduction step and with the surface chemical effects existing between mineral surfaces and/or "growth units". The degree of oxygen-ion polarization may control the surface effects. The ratio Mg^{+2}/H^{+} can change during serpentinization and may control glaucophane or jadeite growth in the presence of excess quartz. The kinetic controls are catalytic and may explain isochemical phenomena. The large negative free energy chain is the source of energy for the drive. — HRC

06696 **Gretener, P. E.** On the mechanics of the intrusion of sills: Canadian Jour. Earth Sci., v. 6, no. 6, p. 1415-1419, illus., 1969.

Diabase sills contain material originating from the base of the crust or the upper mantle. As a result they must be fed by dike- or plug-like bodies. The formation of a sill thus represents a major reorientation of the form of the intrusion. Tabular intrusive bodies tend to orient themselves perpendicular to the least compressive principal stress axis as shown by E. M. Anderson. It is suggested that diabase sills form under sedimentary strata in which the two horizontal principal stresses exceed the vertical stress. Such strata act as stress barriers and prevent further ascent of the magma. In order for this situation to occur the sediments must be in compression in the x-direction and confined in the y-direction. The parameter of importance to produce the above state of stress is the effective Poisson's ratio. — Author's abstract

06712 **Gries, John C.; Haenggi, Walter T.** Structural development of the eastern Chihuahua tectonic belt, northeastern Chihuahua, Mexico [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 83, 1969.

06713 **Grieve, Richard A. F.** Electron micro probe analysis of coronas in the Hadlington gabbroic complex, Ontario, Canada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 83-84, 1969.

06714 **Griffiths, John C.** Cybernetics of the geomathematics interaction [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 84, 1969.

06976 **Groenewold, G. H.; Karner, F. R.** Preliminary classification of concretions and nodules in the Cretaceous Hell Creek Formation, North Dakota [abs.]: North Dakota Acad. Sci. Proc. 1969, v. 23, p. 9, 1969.

Gronberg, Eric C. *See* Murphy, Michael A. 00043

06965 **Grootenboer, Johan; Schwarcz, Henry P.** Experimentally determined sulfur isotope fractionations between sulfide minerals: Earth and Planetary Sci. Letters, v. 7, no. 2, p. 162-166, illus., table, 1969.

Preliminary experimental measurements have been made of the sulfur isotopic fractionation between pyrite, sphalerite, and galena at 340-690°C. Sulfur isotopes were exchanged between each metal sulfide and liquid sulfur. At equilibrium the sequence of S-34/S-32 ratios is pyrite > sphalerite > galena, in agreement with measurements of natural assemblages. Temperatures calculated on the basis of intermineral fractionations for metamorphosed ore deposits give: Heath Steele, N.B. (upper greenschist facies) — 300°C; Broken Hill, N.S.W. (hornblende granulite facies) — 540°C. — Authors' abstract

06716 **Gross, B.; Seifert, K. E.** Possible Grenville inclusions in the Adirondack anorthosite [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 85, 1969.

06717 **Gross, M. Grant.** New York City — A major source of marine sediments [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 85-86, 1969.

00072 **Guedelia, Daniel; Laurent, Jean-Louis; Fontan, Jacques; Blanc, Daniel; Druilhet, Aimé.** A study of radon 220 emanation from soils: Jour. Geophys. Research, v. 75, no. 2, p. 357-369, illus., tables, 1970.

A measurement method of Rn-220 soil emanation is presented. Some measurements are made by means of an experimental model in the laboratory in order to determine the influence of certain parameters on the emanation rate. The seasonal and daily variations of the Rn-220 flux are also studied. It is shown that the seasonal variations are related to soil moisture variations, whereas some daily variations are due to the temperature difference between the air and the soil. — Authors' abstract

06719 **Guillermo, Tomas R.; Wuensch, B. J.** The crystal structure of getchellite, $AsSbS_3$ [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 86-87, 1969.

06488 **Guinnee, John W.; Mobley, A. B.** Soils and rock information — Systems for storage and retrieval, *in* Engineering geology and soils engineering symposium, 7th Ann., Moscow, Idaho, 1969, Proc.: Boise, Idaho, Idaho Dept. Highways, p. 131-143, illus., table, 1969.

Various information storage and retrieval systems are reviewed. The Highway Research Information Service can meet the needs of various groups of individuals. For instance, a chief administrator of a highway department or research organization, a research coordinator, a research project manager, and a laboratory researcher can each find the kind of information he wants on soils and rock, when he wants it. — DBV

06647 **Guyod, Hubert; Shane, Lemay E.** Geophysical well logging — V. 1, Introduction to geophysical well logging; acoustical logging: Houston, Tex., Hubert Guyod, 256 p., illus., tables, 1969.

The purpose of this series of volumes is to present a digest and interpretation of the abundant, but scattered, literature treating principles of geophysical well logging, with a small amount of original work included. Application of logs to formation evaluation and other problems is brief, but physical principles are treated in detail. Only elementary mathematics and physics are applied. This work is applicable to oil

and gas wells, water wells, and holes drilled for other minerals. Part 1 treats geophysical well logging, probe environment and effects of environment. Part 2 on acoustical logging contains chapters on principles of acoustics, elasticity, introduction to borehole acoustics, velocity, velocity measurements, attenuation of casing signal, attenuation measurements, reflected signal, and presentations and applications. — MCM

06720 **Habib, Daniel.** Palynomorph stratigraphy in deep-ocean sediments [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 87, 1969.

06721 **Hadley, Donald G.** Depositional framework of the jasper-bearing conglomerate in the Lorrain Formation, Ontario, Canada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 87-88, 1969.

Haenggi, Walter T. *See* Gries, John C. 06712

06538 **Haglund, David S.; Friedman, Gerald M.; Miller, Donald S.** The effect of fresh water on the redistribution of uranium in carbonate sediments: Jour. Sed. Petrology, v. 39, no. 4, p. 1283-1296, illus., tables, 1969.

Recent carbonate sands and ancient analogs were studied from Bermuda and Israel. The results of the U analyses are compared to established indicators of fresh water alteration in carbonate sediments. As aragonite and Mg-calcite are removed by fresh water and the sample changes from unconsolidated carbonate sand to limestone, there is a concomitant decrease in U content. The U and calcite concentrations show an inverse relation and indicate that the product of fresh water alteration, calcite, accepts less U than the original aragonite. The relations between U and established indicators of fresh water alteration provide converging lines of evidence indicating that fresh water dissolution and replacement of marine carbonates cause a reduction, up to 50 percent, over Pleistocene samples in total sample U content. — *from* Authors' abstract

06722 **Hagner, Arthur F.; Reinking, Robert L.** Source of the ore-forming materials at Iron Mountain, Wyoming [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 88, 1969; Econ. Geology, v. 64, no. 7, p. 834, 1969.

06932 **Hahl, D. C.; Handy, A. H.** Great Salt Lake, Utah — Chemical and physical variations of the brine, 1963-1966: Utah Geol. and Mineralog. Survey Water-Resources Bull. 12, 33 p., illus., tables, 1969.

Surface area and brine concentration of Great Salt Lake vary in response to annual and long-term climatic changes. Sampling of 29 sites indicated that four types of brine coexist in the lake. Brine stratification occurs in the deep parts, and concentration in shallow isolated parts. A railroad causeway cuts off the northwestern part from direct fresh-water inflow, and a salt crust precipitates on the lake bed in summer. The southern part has rarely reached saturation since the causeway was built; the shallow zone of brine varies in concentration from season to season. Two deep brines contain almost the same concentration, intermediate between that in the shallow zone and north of the causeway. Brine in the deep zone at the south end is distinguished by high concentration of sodium and low sulfate. Brine is reddish-brown north of the causeway, and green south of it. — *from* Authors' abstract

06418 **Hajek, B. F.** Chemical interactions of wastewater in a soil environment [with French, German, Portuguese, Spanish abs., p. 1835, 1838, 1840, 1844]: Water Pollution Control Federation Jour., v. 41, no. 10, p. 1775-1786, illus., 1969.

The performance of soil as a wastewater disposal and water reclamation resource often can be predicted from laboratory data which characterize wastewater, soil, and soil-waste water relationships. Many parameters must be studied to assess fully the ability of soil to assimilate wastewater. Some of the significant wastewater parameters are: pH, pollutant form and concentration, concentration of accompanying ions, temperature, and volume disposal characteristics. Significant soil parameters are: bulk density, grain size distribution, mineral composition, exchange capacity, and res-

ident exchangeable cations. Soil-wastewater interrelationships are characterized by batch equilibrium and dynamic soil column studies. Either theoretical or empirical approaches often can be applied to these data and used to predict pollutant migration rates and concentration distributions. — Editor's abstract

06723 **Hales, Anton L.** A seismic discontinuity in the lithosphere [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 88, 1969.

06501 **Hall, Charles E.** The problems of tunnel exploration, *in* Engineering geology and soils engineering symposium, 7th Ann., Moscow, Idaho, 1969, Proc.: Boise, Idaho, Idaho Dept. Highways, p. 3-8, 1969.

Optimal approach for a tunnel investigation consists of regional reconnaissance mapping, followed by detailed alinement mapping, followed by seismic and(or) resistivity investigations, and confirmed by drilling wherever time, money, and access permit. Seismic velocity is a good indicator of the engineering characteristics of a rock. In certain rock types, resistivity indicates the water table and is particularly applicable for locating a soil-rock interface. In crystalline rocks containing magnetite, a magnetic survey often will reveal shear zones, as magnetite is one of the first minerals to be removed by waters percolating along faults. Gravity surveys pick up intrusions of small, hard igneous bodies in sedimentary formations. — DBV

07039 **Hall, John W.** Studies on fossil *Azolla* — Primitive types of megaspores and massulae from the Cretaceous: Am. Jour. Botany, v. 56, no. 10, p. 1173-1180, illus., 1969.

A new genus, *Parazolla*, from the Claggett Shale of Montana, has megaspores in which the swimming apparatus is composed of a number of elongate floats attached to the megaspore body and invested by coiled hairs. The floats separate at maturity. Massulae, bearing microspores, have simple hair-like glochidia, many of which are knobbed at their tips. Glochidia tend to resemble the perisporial hairs of the megaspore body. This resemblance provides fossil evidence of the homology of these two hair-like structures among living species of *Azolla*. In *Azolla simplex*, from the Judith River Formation of Montana, the megaspore has a single cap-like so-called columellate float. Massulae, which have anchor-shaped glochidia, are associated with these megaspores. — *from* Author's abstract

06724 **Hall, Minard L.; Hower, John, Jr.** Insensitivity of cation fractionation between biotite, chlorite, garnet, and muscovite to progressive metamorphism [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 89, 1969.

06469 **Ham, William E.** (and others). Regional geology of the Arbuckle Mountains, Oklahoma: Oklahoma Geol. Survey Guidebook 17, 52 p., illus., table, geol. map, 1969.

This guidebook contains two parts, a preliminary, brief description of the regional geology of the range and a road log for a two-day field trip. Rocks from Precambrian to Pennsylvanian age and the complex structures of the range are discussed. The field trip, 93 miles long, begins at Davis, goes to Springer, and then from east of Mannsville back to Davis. Several papers dealing with specific aspects of the geology enroute are included and are cited separately by author. The geological map is that by Ham and McKinley. — HRC

06892 **Hamilton, R. M.; Healy, J. H.** Aftershocks of the BENHAM nuclear explosion: Seismol. Soc. America Bull., v. 59, no. 6, p. 2271-2281, illus., tables, 1969.

The BENHAM nuclear explosion, a 1.1 megaton test 1.4 km beneath Pahute Mesa at the Nevada Test Site, initiated a sequence of earthquakes lasting several months. The epicenters of these shocks were located within 13 km of ground zero in several linear zones that parallel the regional fault trends. Focal depths range from near surface to 6 km. The earthquakes are not located in the zone of the major ground breakage. The earthquake distribution and fault plane solutions together indicate that both right-lateral and strike-slip fault movement and dip-slip fault movement occurred. The explosion apparently caused the release of natural tectonic strain. — Authors' abstract

06581 **Hammack, Gregory W.** Time-share computer assists log analysts: Petroleum Engineer, v. 41, no. 13, p. 58-60, illus., tables, 1969.

Major advantages of the time-share computer over mechanically digitized logs are complete control of input data and monitoring of results as they are received. The mechanics and instruments used in this computer system are described. In order to use the time-sharing system, log data must be converted from analog to digital form by hand. For a continuous graphical output, logs must be digitized in one- or two-ft increments. This hand-digitizing process is time-consuming but offers flexibility. Applications and examples are given. — ESL

06533 **Hand, Bryce M.; Wessel, James M.; Hayes, Miles O.** Antidunes in the Mount Toby Conglomerate (Triassic), Massachusetts: Jour. Sed. Petrology, v. 39, no. 4, p. 1310-1316, illus., 1969.

Nineteen sand waves, considered antidunes, are exposed on a bedding plane of Mount Toby Conglomerate near Sunderland. They are nearly symmetrical, with smoothly rounded crests somewhat sharper than the intervening troughs; slip faces are not developed. Average wave length is 63.3 cm, average height 6.5 cm. Cross laminae within waves are parallel to upstream wave fronts, indicating that the antidunes were migrating upstream. Current direction is known independently from cobble imbrication in adjacent beds, regional grain size trends, oriented structures, and known source areas. The antidunes formed in water about 1.6 cm deep, flowing at 100 cm/sec down a paleoslope of at least 2.7°, compatible with sheetwash on the surface of an alluvial fan. Upstream-dipping cross laminae are not limited to the unit displaying sand waves, but occur abundantly in many other beds. — *from* Authors' abstract

07016 **Hand, Bryce M.** Antidunes as trochoidal waves: Jour. Sed. Petrology, v. 39, no. 4, p. 1302-1309, illus., 1969.

Computer-generated trochoids accurately describe profiles of both natural and laboratory antidunes. The ratio of current velocities at crest and trough can be calculated for flow over stationary trochoidal waves of any particular steepness, and must equal the inverse ratio of water depths at these positions. Antidune height H_b can therefore be expressed as a function of water wave height H_w, wave length L, and mean water depth d: $H_b = H_w(1 - 2\pi d/L)$. By assuming the steepest possible water waves ($H_w/L = 0.142$), it is possible to derive a maximum estimate of water depth for a set of preserved antidunes. A technique for reconstructing the original bedform from a small amount of preserved cross-lamination allows these calculations to be applied even where the antidunes themselves have not been preserved. — *from* Author's abstract

Handy, A. H. *See* Hahl, D. C. 06932

06725 **Hanor, Jeffrey S.** Compositional zoning in concretions [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 89, 1969.

Hansen, John. *See* Sörensen, Henning. 07026

06380 **Harbison, Reginald N.** Possible morainal deposits in the Gulf of Maine: Maritime Sediments, v. 5, no. 1, p. 19-21, illus., 1969.

Shadow zones on seismic reflection profiles are interpreted as records of glacial debris deposits. In areas where shadow zones are present, closed bedrock lows and maximum sediment thickness occur together; the lows are attributed to glacial erosion and areas of maximum thickness are interpreted to be associated with glacial stillstand. Absence of these shadow zones to the south and their concentration along a 14-km-wide belt in the vicinity of the 90 m isobath may indicate a former glacier-shoreline contact. The Passadumkeag topographic sheet shows sand and gravel morainal deposits extending to the present shoreline just north of Area A; the shadow zones are probably a southern continuation of these. Gulf of Maine morainal deposits are interpreted as gentle subbottom ridges of sand and gravel of an end moraine complex similar to that on the Scotian Shelf which they resemble. — *from* Author's conclusions

06726 **Hardie, Lawrence; Eugster, Hans P.; Jones, Blair F.** Evaporative concentration of closed basin waters [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 90, 1969.

06942 **Hargraves, R. B.; Young, W. M.** Source of stable remanent magnetism in Lambertville diabase: Am. Jour. Sci., v. 267, no. 10, p. 1161-1177, illus., 1969.

Measurement of natural, thermal, and saturation remanent magnetism and their stability with respect to alternating field and thermal demagnetization of concentrates of plagioclase, pyroxene, and oxide (80 percent ilmenite, 20 percent magnetite) separated from a sample of diabase from the Triassic Lambertville (N. J.) sill, reveal that the stable remanence of the whole rock is associated with the silicates and especially with the plagioclase. Measurement of Curie point and saturation moment of the feldspar indicates the presence of about 0.3 percent Fe ion in solid solution and 0.004 percent pure magnetite as a discrete phase. This magnetite cannot be identified microscopically, nor with an electron probe, and it is inferred to be present as submicroscopic, single domain particles. — Authors' abstract

Harris, Rae L. *See* Craig, James R. 06769

06746 **Harris, William H.** Coastal phreatic diagenetic environments, coral cap of Barbados, West Indies [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 90-91, 1969.

Harrison, C. G. A. *See* Sclater, J. G. 00073

06576 **Harrison, W.** Empirical equations for foreshore changes over a tidal cycle: Marine Geology, v. 7, no. 6, p. 529-551, illus., tables, 1969.

At Virginia Beach, Va., net change in quantity of foreshore sand ΔQ_f, advance or retreat of the shorelines, ΔS; and mean slope of the foreshore, m, were investigated. Linear multiregression of the time-series data resulted in useful prediction equations of moderate strength. Most of the variability of erosion or deposition on the foreshore is explained by three variables. Advance or retreat of mean high water line is determined by three variables. The mean beach slope is dependent mostly upon two variables. Owing to the complexly-interlocked nature of the variables in the beach-ocean-atmosphere system, it would seem that the best prospect for valid predictions of changes in beach geometry will lie in empirical equations. — *from* Author's summary

06727 **Hart, Peter.** Curtain grouting through an embankment — Alvin R. Bush Dam [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 91, 1969.

06728 **Harvill, Lee L.** An improved method for interpreting deformation lamellae in quartz [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 91-92, 1969.

06930 **Hase, D. H.; Campbell, Russell B.; VanEck, Orville J.** Iowa gravity base station network: Iowa Geol. Survey Rept. Inv. 8, 17 p., illus., tables, 1969.

In the spring of 1967, the Iowa Geological Survey established 42 gravity base stations at airports throughout the state to provide a more adequate and extensive gravity base station network than had existed previously. Measurements were made with LaCoste-Romberg geodetic gravity meters and were tied to the U.S. National Gravity Base Net through station Minneapolis L (I.G.C. 15443L). For all but one station, the maximum network uncertainty at any station is ± 0.041 milligal. One U.S. Air Force and two Woollard and Rose (1963) stations were recovered, and the differences in observed gravity measured by the Iowa Geological Survey and reported at these stations are -0.005, 0.00, and -0.02 milligal respectively. — Authors' abstract

06729 **Hassard, John R.; Abruscato, Joseph.** Sensitizing potential ESCP teachers to classroom behavior and inquiry techniques of teaching — A workshop [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 92, 1969.

Hatten, C. W. *See* Meyerhoff, A. A. 07032

06436 **Hattin, Donald E.; Frey, Robert W.** Facies relations of *Crossopodia* sp., a trace fossil from the Upper Cretaceous of Kansas, Iowa, and Oklahoma: Jour. Paleontology, v. 43, no. 6, p. 1435-1440, illus., table, 1969.

Specimens of *Crossopodia* M'Coy, 1851 have been collected in fine- to very fine-grained terrigenous and carbonate rocks of the Dakota, Graneros, Greenhorn, and Carlile formations (Upper Cretaceous) of Kansas, Oklahoma, and Iowa. A majority of the specimens are preserved as convex epireliefs; crawling and resting traces are differentiated on the basis of gross morphology. *Crossopodia* sp. was formed by facies-crossing worms or crustaceans, and preservation was apparently controlled by character of the substrate. — Authors' abstract

06928 **Hawkins, Larry K.** Visual observations of manganese deposits on the Blake Plateau: Jour. Geophys. Research, v. 74, no. 28, p. 7009-7017, illus., 1969.

Visual observations of manganese deposits on the Blake Plateau from a manned submersible indicate that the occurrence of manganese as nodules, slabs, or pavement may be related to localized environmental conditions. Manganese is concentrated at the crests of sand waves and, in areas of gentle slope, grades locally from nodules to solid pavement. — Author's abstract

06730 **Hay, R. L.; Burns, Lary K.; Drake, Robert.** Palagonitic alteration along steaming cracks in Kilauea caldera, Hawaii [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 92-93, 1969.

06731 **Hay, William W.** Calcareous nannofossils and deep sea stratigraphy of the western South Atlantic and Caribbean [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 93-94, 1969.

Hayes, D. E. *See* Ewing, M. 06748

Hayes, Miles O. *See* Hand, Bryce M. 06533

06733 **Hayes, Miles O.; Boothroyd, Jon C.** Storms as modifying agents in the coastal environment [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 94-95, 1969.

Hayes, Miles O. *See* Galvin, Cyril J., Jr. 06816

06732 **Hays, James D.** Paleomagnetically controlled late Cenozoic radiolarian stratigraphy in high and low latitudes [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 94, 1969.

06891 **Hays, W. W.** Amplitude and frequency characteristics of elastic wave types generated by the underground nuclear detonation, BOXCAR; Seismol. Soc. America Bull., v. 59, no. 6, p. 2283-2293, illus., tables, 1969.

Elastic wave types generated by the BOXCAR underground nuclear detonation were identified and analyzed to determine amplitude and frequency characteristics as a function of distance. Amplitude characteristics of the identified wave types varied with distance and frequency. Within each body wave subset, refracted wave amplitude decays most rapidly and reflected wave amplitude least rapidly with distance. Fourier amplitude spectrums of the P, S, and surface wave time windows exhibit maximums at different spectral frequencies for stations on rock, ranging from a dominant frequency of about 0.8 Hz for the P-wave window to about 0.25 Hz for the surface wave window. Frequency of maximum amplitude of each of the three wave mode window spectral sets is essentially unaffected by increase in propagation distance over the distance range 22.2-79.1 km. — *from* Author's abstract

06734 **Head, James W.** Correlation and paleogeography of the upper part of the Helderberg Group (Lower Devonian) of the central Appalachians [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 95, 1969.

Healy, J. H. *See* Hamilton, R. M. 06892

06735 **Heaslip, William Graham.** A new cyclocystoid (Echinodermata) from Cortland, New York, extends class stratigraphic range to Upper Devonian [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 96, 1969.

07014 **Hedge, Carl E.; Peterman, Zell E.** Sr^{87}/Sr^{86} of Circum-Pacific andesites [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 96, table, 1969.

06736 **Heezen, B. C.; Fischer, A. G.; Boyce, R. E.; Bukry, D.; Douglas, R. G.; Garrison, R. E.; Kling, S. A.; Krasheninnikov, V.; Lisitzin, A. P.; Pimm, A. C.** Preliminary scientific results of Cruise 6 D/V GLOMAR CHALLENGER, west Pacific [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 97, 1969.

Heezen, B. C. *See* Fox, P. J. 06809

07003 **Heezen, Bruce C.; Johnson, G. Leonard; Hollister, Charles D.** The Northwest Atlantic Mid-Ocean Canyon: Canadian Jour. Earth Sci., v. 6, no. 6, p. 1441-1453, illus., 1969.

The Northwest Atlantic Mid-Ocean Canyon is a depositional-erosional linear feature which extends southward from the northern Labrador Sea to the Sohm Abyssal Plain. Analysis of the data accumulated over the past 20 yr allows us to conclude: (1) The canyon does not have any major tributaries; (2) it is Quaternary in age; and (3) it is not a tectonic feature. However, neither the source nor the sedimentary process which constructed the canyon can as yet be established. — Authors' abstract

06875 **Helmlich, Richard A.** Reconnaissance petrology of Precambrian rocks in the Bighorn Mountains, Wyoming: Wyoming Univ. Contr. Geology, v. 8, no. 1, p. 47-61, illus., tables, 1969.

Seven mappable lithologic units are recognized: a southern gneiss terrane of plagioclase-quartz gneiss, augen gneiss, amphibolite, and a quartz-diorite body; and a northern granitic terrane of intergradational, scattered bodies of quartz monzonite, quartz diorite, and agmatite. Regional synformal structures with steep dips are defined by foliation in both terranes; with local exceptions, contacts between rock units are broadly parallel to regional strike of foliation — E-W, E-NW, and NE-SW. Many rock units are transgressed by limited shear zones and marked by retrograde metamorphism as well as faults. The northern granitic complex evolved essentially contemporaneously with the southern gneiss during a period of metamorphism and metasomatism; late mobility of potash at the north end converted the gneiss there to granitic rocks. The isolated Bald Mtn. area may represent the center of such metasomatic activity. — GDC

Heizer, Robert F. *See* Hole, Frank. 06579

06737 **Hekinian, Roger.** Petrological and geochemical study of spilite and associated dike rocks from the Virgin Island core (Caribbean Island arc) [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 97-98, 1969.

Helander, D. P. *See* Desai, K. P. 06867

Helmstaedt, H. *See* Gavasci, A. T. 06557

06397 **Henderson, Bonnie C.** Student enrollment in Earth science, 1968-69: Geotimes, v. 14, no. 9, p. 18-20, illus., table, 1969.

Results of the American Geological Institute's annual survey of enrollment in geoscience departments in colleges and universities of the United States and Canada are divided into students in degree programs and students in nonmajor earth science. Quotations on employment trends and effect of the military draft are included. The number of actual degrees granted is discussed and shown on graphs. Results of the survey are shown in a full-page table. — ESL

06479 **Henderson, G.** Oil and gas prospects in the Cretaceous-Tertiary basin of West Greenland: Grönlands Geol. Undersögelse Rap. 22, p. 1–52, 60–63, illus., tables, 1969.

The basin contains marine and nonmarine sediments ranging from Lower Cretaceous to Paleocene. Marine sediments are at least 1500 m thick in parts of Nûgssuaq and may reach 2000 m; nonmarine attain a thickness of 1500 m in Nûgssuaq and Disko. Up to 8 km of Tertiary basalt overlie the sediments in much of the area. The basin is fault-bounded and its coastline was probably fault-determined. Most of the sediments are sandstone and shale, and bituminous shales are an important part. Results of chemical analyses of oil source rocks are included in an appendix [by N. B. H. Stevens, cited separately]. Migrated hydrocarbons occur in a sandstone close to a fault. Sandstones are good potential reservoir rocks, and good possibilities for traps are present at depth. Further exploration is encouraged. — *from* Author's abstract

Hendrickson, Larry G. *See* Lund, John W. 06645

00030 **Hermes, O. Don.** Petrochemistry of coexistent mafic silicates from the Mecklenburg gabbro-metagabbro Complex, North Carolina: Geol. Soc. America Bull., v. 81, no. 1, p. 137-163, illus., tables, 1970.

The complex consists of older metagabbro and felsic metaplutonic rocks of upper amphibolite rank, and a younger post-metamorphic gabbro. Gabbros contain olivine, orthopyroxene, clinopyroxene, hornblende, and biotite in hypidiomorphic textures with reaction relations among the first four. Metagabbro lacks olivine and has textures, ranging from relict igneous (Type 1) to recrystallized granoblastic (Type 2), apparently representing equilibrium metamorphic assemblages. Electron microprobe analyses of mafic silicates imply that: minerals of Type 1 have not completely equilibrated during metamorphism, and the recrystallization process evidently involved *continuous rehomogenization* of mafic phases. Coexistent pairs from gabbro commonly show less fractionation than metagabbro pairs, possibly owing to higher temperatures of equilibration or by compositional variables not considered in the exchange reaction. — RAL

Heron, S. Duncan, Jr. *See* Bartlett, Charles S., Jr. 06994

07004 **Heron, S. Duncan, Jr.; Johnson, Henry S., Jr.** Radioactive mineral resources of South Carolina: South Carolina Div. Geology Misc. Rept. MR-4, 4 p., illus., 1969.

South Carolina's principal uranium resources are associated with phosphate deposits of the Cooper Marl and Hawthorne Formation in the lower Coastal Plain. Available analyses indicate an average U content of 0.043 percent in the phosphate rock. Phosphate resources, in concentrate of tens to hundreds of million tons, currently appear to be economically marginal; recovery of uranium is feasible only as a byproduct. Trace amounts of uranium are known in a few pegmatites and scattered in Piedmont gneissic and granitic rocks. Thorium occurs in relative abundance in some monazite placers in the Piedmont and Coastal Plain. At present there appear to be no workable uranium deposits in the State, until the phosphate is produced. Recovery of uranium from quarry screenings of granite and gneiss is conceivable. Extensive acid and mafic volcanic rocks of the Carolina Slate Belt would seem a likely source. — GDC

Hester, N. C. *See* Pryor, W. A. 06495

06738 **Heusser, Calvin J.** Pleistocene environments and chronology of the western Olympic Peninsula, Washington [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 99, 1969.

Heymann, D. *See* Taylor, G. J. 06966

06938 **Hibbard, Claude W.** The rabbits (*Hypolagus* and *Pratilepus*) from the upper Pliocene, Hagerman local fauna of Idaho: Michigan Academician, v. 1, nos. 1-2, p. 81-97, illus., tables, 1969.

Three species of rabbits were recovered from the Glenns Ferry Formation near Hagerman. The most abundant is *Hypolagus* sp. *aff. H. vetus*, which decreases in abundance upwards. At least 75 individuals were studied. *H. limnetus* is poorly represented, but found throughout the section. *Pratilepus vagus*, the second most

abundant rabbit, was concentrated from 3,250 to 3,300 feet elevation. Teeth of these three species were found ranging throughout a vertical section of 400 feet. No change in dental pattern was found in any of the three. — ESL

06999 **Hohenberg, C. M.; Reynolds, J. H.** Preservation of the iodine-xenon record in meteorites: Jour. Geophys. Research, v. 74, no. 27, p. 6679-6683, illus., table, 1969.

In I-Xe dating of the Abee enstatite chondrite by a technique that combines neutron activation and stepwise mass spectrometric analysis of the xenon subsequently released by heating, one sample was preheated to 1200°C in vacuum before the neutron irradiation. Although most of the xenon was expelled in the preheating, the basic I-Xe correlation was undisturbed even in a range of temperatures where there had been substantial loss of radiogenic Xe-129 due to the preheating. The result suggests that I-Xe dating depends for its validity not upon quantitative retention but upon what is effectively proportionate I-Xe retention. One model which exhibits this behavior would have the retentively sited iodine and radiogenic Xe-129 coexisting at trapping sites, which undergo thermal rupture as heating proceeds until thermal rupture, the trapping sites retain both I and Xe quantitatively. — Authors' abstract

Holden, J. C. *See* Dietz, R. S. 06783

06700 **Holdsworth, Gerald.** An examination and analysis of the Formation of transverse crevasses, Kaskawulsh Glacier, *in* Icefield Ranges Research Project scientific results, V. 1 (V. C. Bushnell and R. H. Ragle, editors): New York, Am. Geog. Soc., and Montreal, Quebec, Arctic Inst.North America, p. 109-125, illus.,tables,revised 1969; originally published 1965.

The purpose of this investigation was to examine applicability of Nye's theoretical expression for longitudinal strain rate on a valley glacier's surface, and to investigate mechanics and mode of formation of transverse crevasses. Result of comparison between measured and computed strain rates is inconclusive because assumptions are not valid except in one short section. A value of regional longitudinal extending strain rate of about 3.5×10^{-5} day^{-1} is associated with occurrence of the first transverse crevasse in previously unfractured firn. Localized strain rates and stresses of at least an order of magnitude greater than regional values are deduced to be responsible for ice fracturing. The crevasses appear to be forming at ice-stream margins and propagating towards the center, suggesting an elastic behavior. [Originally published as Ohio State Univ. Inst. Polar Studies Rept. 16, 1965.] — *from* Author's abstract

06579 **Hole, Frank; Heizer, Robert F.** An introduction to prehistoric archeology (2d edition): New York, N.Y., Holt, Rinehart and Winston, 497 p., illus., 1969; originally published 1965.

Revisions of this text consist of updating technical sections, introducing new and more advanced interpretive theory, expanding parts of original text, and including topical bibliographies at the ends of chapters. Chapters of particular interest are those in part 4, dating the events of prehistory — dating by physical-chemical methods, geochronology, methods for dating, using plant and animal remains, and other methods of dating. A 70-page bibliography is appended. — MCM

Holland, F. D., Jr. *See* Feldmann, Rodney M. 06973

Holland, F. D., Jr. *See* Royse, C. F., Jr. 06977

Hollister, Charles D. *See* Heezen, Bruce C. 07003

06651 **Holmes, Doris L.** Elements of physical geology (*adapted from* Principles of physical geology, 2d edition, *by* Arthur Holmes): New York, Ronald Press Co., 271 p., illus., tables, 1969; originally published 1965.

This adaptation deals with standard topics of physical geology required for beginner courses in colleges and universities. The formidable size of the second edition proved overwhelming to beginning students, so this adaptation should fulfill the need for a

shorter text. The book is divided into three parts: (1) preliminary survey — shape, surface relief and changing face of the Earth, materials and architectural features of the crust; (2) external processes (Earth sculpture) — rock weathering and soils, underground waters, river action and valley development, river systems and associated landforms, glaciers and glaciation, wind action and desert landscapes, coastal scenery and work of the sea, submarine landforms, coral reefs, and marine deposits; (3) internal processes (major architectural forms) — Earth movements, volcanoes and volcanic edifices. — MCM

06910 **Hood, Peter; Ward, S. H.** Airborne geophysical methods, *in* Advances in geophysics, V. 13 (H. E. Landsberg and J. van Meighem, editors): New York and London, Academic Press, p. 1-112, illus., tables, 1969.

This review is an attempt to describe generally and discuss critically some of the airborne geophysical methods that have had successful application in recent years; there is greater emphasis on existing prospecting methods than those utilized for military, geodetic, and other applications. Methods have been grouped under the following headings: aeromagnetic, low-frequency electromagnetic, radiometric, gravity, and other remote-sensing techniques (ultraviolet, infrared, microwave, and radar). — MCM

00015 **Horai, Ki-iti; Chessman, Mary; Simmons, Gene.** Heat flow measurements on the Reykjanes Ridge: Nature, v. 225, no. 5229, p. 264-265, illus., table, 1970.

Ten new heat flow measurements on the crest of the Reykjanes Ridge are presented. Values (in μ cal per sq cm per sec) range from 0.80 to 6.71, with an average of 2.89. The two peaks of high heat flow coincide with topographic depressions on both sides of the ridge crest and with the number 2 magnetic anomalies; the causative relationships among these anomalies, however, cannot be inferred from the single traverse. — DBV

06961 **Horai, Ki-iti.** Cross-covariance analysis of heat flow and seismic delay times for the Earth: Earth and Planetary Sci. Letters, v. 7, no. 2, p. 213-220, illus., table, 1969.

A correlation between heat flow, Q, and seismic delay time, Δt, is demonstrated by cross-covariance analysis. For worldwide data, an empirical relationship $Q(10^6 \text{ cal/cm}^2\text{sec}) = 0.69\ \Delta t\ (\text{sec}) + 1.67$ is proposed. Auto-covariance analysis of Q and Δt show that the distribution of data for Δt is more biased than that of Q. — Author's abstract

06510 **Hornby, M. R.; Scott, W. B.** A surface replica technique for the examination of quartz sand grains in the electron microscope: Jour. Sed. Petrology, v. 39, no. 4, p. 1608-1610, illus., 1969.

An improved method for preparing surface replicas of quartz sand grains using water soluble polyvinyl alcohol is described. — Authors' abstract

06944 **Hörz, Friedrich; Ahrens, Thomas J.** Deformation of experimentally shocked biotite: Am. Jour. Sci., v. 267, no. 10, p. 1213-1229, illus., tables, 1969.

Shock experiments (10-40 kb) on lepidomelane show that kinking occurs at pressures as low as 9 kb; the intensity is related to peak pressure and shock pulse duration (0.7-0.3μ sec.), and is produced by shocks propagated along [hk0] and not along [001]. The shock-induced kinks have a wider range of their angle of external rotation (19-121°) than their static counterparts (40-60°). The ratio of the kink angles, ϵ and δ, scatters widely, indicating shock induced kinking is highly asymmetrical. A marked decrease of 2V from 24 to 7° with increasing pressure is observed. Laue transmission patterns show that permanent angular rotations as great as 4.4° are induced by shock pressures of 37.5 kb. In individual samples the increase in permanent angular rotations and decrease in 2V can be closely correlated. — *from* Authors' abstract

Hostetler, P. B. *See* Christ, C. L. 06757

06650 **Hough, B. K.** Basic soils engineering (2d edition): New York, Ronald Press Co., 634 p., illus., tables, 1969; originally published 1957.

The scope of this textbook is the entire field of soils engineering; material, assembled from engineering, agronomy, and soil sciences, is presented in engineering terms. Applications are made in the fields of hydraulics, mechanics, foundations, and highway engineering. Special attention has been given in this edition to the subject of spread foundations, including material of recent date on mats and floating foundations. Extensive use has been made of numerical examples. Chapter headings are: introduction; index properties; soil moisture; soil structure; compressibility; shearing strength; stress analysis; earth slopes and embankments; spread foundations; pile and caisson foundations; retaining walls, sheeting, and anchors; subgrades and pavement thickness; soil compaction and stabilization; and site investigation. — MCM

06984 **Houser, F. N.** Subsidence related to underground nuclear explosions: Seismol. Soc. America Bull., v. 59, no. 6, p. 2231-2251, illus., table, 1969.

Subsidence of the ground surface in desert alluvium of Yucca Flat by collapse of volcanic rocks and(or) alluvium into the cavities formed by nuclear explosions has been studied as part of a comprehensive investigation of the mechanism of collapse of such cavities; sinks are described. A working model of collapse includes maintenance of the explosion cavity until main collapse occurs, and a two-phase collapse taking place in several seconds or several tens of seconds, culminating in surface subsidence if the cavity is sufficiently close to the surface. In alluvium, the first phase consumes 70-90 percent of the collapse period; collapse propagates upward at rates of 50-80 feet per sec. The second phase shows faster upward propagation, a lesser particulation of the collapse material, and ends with drop of a central mass of alluvial material to form the sink. — DBV

Houston, Robert S. *See* Barnes, Charles W. 06869

Houtz, R. *See* Ewing, John I. 06562

Howe, David A. *See* Craig, James R. 06769

06551 **Howe, Herbert J.** Rhynchonellacean brachiopods from the Richmondian of Tennessee: Jour. Paleontology, v. 43, no. 6, p. 1331-1350, illus., tables, 1969.

Silicified material of the Upper Ordovician Richmond Group (Arnheim and Fernvale Formations) in central Tennessee has yielded four species of *Lepidocyclus* and one of *Rhynchotrema* (none new), suggesting affinities with the Maquoketa as well as with the type Richmond. *Lepidocyclus ? capax* (Conrad) and *R. dentatum* (Hall) are confined to the Arnheim and basal Fernvale; *L. manniensis* (Foerste), *L. cooperi* Howe, and *L. ? rowleyi* (Foerste) are found only higher in the Fernvale. Lithology and paleoecological evidence suggest a quiet environment during Arnheim deposition and strong bottom currents predominating during Fernvale deposition. — REG

Hower, John, Jr. *See* Hall, Minard L. 06724

00005 **Hughes, Dan A.** Las Tiendas Field, Webb County, Texas: South Texas Geol. Soc. Bull., v. 10, no. 4, p. 3-10, illus., 1970.

Las Tiendas is a large multipay gas structure producing 20 million cubic feet per day from Wilcox sands at 2,000 to 3,600 feet. Regional mapping had showed a large flat area, and two test wells drilled encountered gas shows. The Escondido gave a good reflection and an isopach map was made between this and the Lower Wilcox, and the structure projected. The high on the Wilcox was a low on the Escondido. Four structure contour maps on the producing sands show that the structure becomes more pronounced at shallower depths due to sand buildup. The logging procedure that proved best for evaluating these wells was a simple induction log and a compensated density log. — ESL

07019 **Hughes, George M.; Farvolden, Robert N.; Landon, Ronald A.** Hydrogeology and water quality at a solid waste disposal site, *in* Engineering geology and soils engineer-

ing symposium, 7th Ann., Moscow, Idaho, 1969, Proc.: Boise, Idaho, Idaho Dept. Highways, p. 116-130, illus., tables, 1969.

Hydrogeologic study of four refuse disposal sites in northeastern Illinois, one of which is described, indicates that under prevailing climatic and soils conditions and many current landfill construction procedures, precipitation will infiltrate to produce a leachate high in dissolved solids. In much, though not all, of the area the leachate is assimilated by the natural environment without significantly affecting ground- or surface-water resources. The study further indicates that the probable effects of solid waste-disposal sites can, in many cases, be quantitatively determined. Therefore, such sites can and should be selected, constructed, and operated so that the effluent will meet water quality standards in the same manner as that of sewage treatment plants. — Authors' abstract

06524 **Hunter, Ralph E.** Eolian microridges on modern beaches and a possible ancient example: Jour. Sed. Petrology, v. 39, no. 4, p. 1573-1578, illus., 1969.

The structure here named eolian microridges consists of a series of anastomosing ridges less than 1 cm. in wave length. Eolian microridges have been observed to form where sand was being blown in saltation across wet sand surfaces, mostly on beaches. The ridges and intervening troughs are oriented transversely to wind direction and commonly have several types of asymmetry by which the direction of the wind that formed them can be determined. The structure may be distinguished from ordinary ripples of unusually small wave length by several criteria other than wave length. Eolian microridges are potentially preservable, and structures found on several bedding planes of the Keefer Sandstone (Middle Silurian) near Lewistown, Pa., are possibly preserved examples. These structures, together with other evidence, strongly suggest a beach environment for this sandstone. — Author's abstract

06498 **Idaho Department of Highways; Idaho Univ. Colls. Eng. and Mines; Idaho State University Dept. Geology.** Proceedings of the 7th annual engineering geology and soils engineering symposium, Moscow, Idaho, 1969: Boise, Idaho, Idaho Dept. Highways, 289 p., illus., 1969.

These proceedings include 23 papers (4 are abstracts only) on a variety of topics in engineering geology including soil and rock mechanics, geologic problems associated with tunnel, highway, and dam construction and mine development, slope stability, erosion control, material properties, and soils problems. The individual papers are cited separately. — VSN

Idaho State University Dept. Geology. *See* Idaho Department of Highways. 06498

Idaho Univ. Colls. Eng. and Mines. *See* Idaho Department of Highways. 06498

Isphording, Wayne C. *See* Enright, Richard C. 06797

Jackson, E. D. *See* Beeson, M. H. 06838

Jackson, Everett D. *See* Beeson, Melvin H. 06451

06912 **Jambor, J. L.** Dadsonite (minerals Q and QM), a new lead sulphantimonide: Mineralog. Mag., v. 37, no. 288, p. 437-441, tables, 1969.

Dadsonite was previously described as mineral Q from Yellowknife, N.W.T.; mineral QM from Madoc, Ontario, and Pershing County, Nev. Material from Wolfsburg, Germany, yields good powder patterns identical with those from QM, and single crystal data identical with those for Q. Microprobe analysis of the Nevada and Wolfsburg samples gave respectively, Pb 49.3, 50.8; Sb 31.7, 31.8; S 20.7, 20.3; sum 101.7, 102.9 percent, giving $Pb_{11}Sb_{12.0}S_{29.8}$ and $Pb_{11}Sb_{11.7}S_{28.4}$, ideally $Pb_{11}Sb_{12}S_{29}$ or $11PbS.6Sb_2S_3$. Dadsonite is acicular [010] monoclinic, space group P2, *Pm*, or P2/*m*, with a 19.05, *b* 4.11, *c* 17.33A, beta 96°20′, Z=1, Sp. gr. 5.76. Strongest lines of the X-ray pattern are 3.78 (7), 3.62(6), 3.38 (10), 2.84 (7), and 2.79 A (6).—*from* Author's summary

07008 **Jambor, J. L.** Sulfosalts of the plagionite group: Mineralog. Mag., v. 37, no. 288, p. 442-446, illus., tables, 1969.

Three of the members of the plagionite group, füllöppite $Pb_3Sb_8S_{15}$, plagionite $Pb_5Sb_8S_{17}$, and semseyite $Pb_9Sb_8S_{21}$, show linear correlations of cell volume and density versus $PbS:Sb_2S_3$ mol ratios. This relationship can be used better to define the nature of the fourth member of the group, heteromorphite, $Pb_7Sb_8S_{19}$. The cell dimensions derived for heteromorphite are a 13.60, b 11.93, c 22.21 A, β 90°50′. — Author's summary

06884 **James, Laurence B.; Arnold, Arthur B.; Marlette, John W.** California State Water Project, Field Trip 1 *in* 1969 field trips — Assoc. Eng. Geologists, Natl. Mtg., San Francisco, Calif., 1969: [Berkeley, Calif.] Assoc. Eng. Geologists, p. A1-A20, illus., tables, 1969.

This is the guide to Field Trip 1, covering a part of the California State Water Project. The first part was a charter flight from San Francisco to Clifton Court Forebay, southeast of Stockton, and thence southward to inspect part of the California Aqueduct. Within-flight briefings are included on the engineering geology and its relation to construction. At Bakersfield the group transferred to buses for a tour of the pumping plants, tunnels, canals, dams, and powerplant sites comprising the Tehachapi Mountain crossing and West Branch aqueduct facilities. The last part was the return flight to San Francisco, following the San Andreas fault trace. — DBV

Japp, R. D. *See* Yong, R. N. 06487

Jenkins, Gomer. *See* Dean, Thomas J. 06652

06941 **Jerison, Harry J.** Brain evolution and dinosaur brains: Am. Naturalist, v. 103, no. 934, p. 575-588, illus., table, 1969.

There is a popular misconception that dinosaurs had unusually small brains. Although their brains may have been small compared with the brains of the mammals, the appropriate comparison is with reptilian brains. Such a comparison shows that the brains of dinosaurs were normal in size for reptiles, and the evidence is summarized in this report. The conclusion is important for our understanding of the evolution of the vertebrate brain and intelligence because, combined with other data, it suggests that the brain evolved conservatively and that vertebrate species rarely responded to selection pressures by producing larger brains. Selection pressures which favored more "intelligent" over less "intelligent" species must have been rare. — *from* Author's introduction

06975 **Johnson, A. R., Jr.; Pederson, J. E.** Differential spectrophotometric determination of zirconium in the presence of hafnium with Methylthymol Blue [abs.]: North Dakota Acad. Sci. Proc. 1969, v. 23, p. 12, 1969.

Johnson, Arvid M. *See* McCulloch, D. S. 06987

Johnson, E. L. *See* Bell, J. R. 06492

Johnson, G. Leonard. *See* Heezen, Bruce C. 07003

Johnson, Henry S., Jr. *See* Bartlett, Charles S., Jr. 06994

Johnson, Henry S., Jr. *See* Heron, S. Duncan, Jr. 07004

06430 **Johnson, J. G.; Reso, Anthony; Stephens, Michael.** Late Upper Devonian brachiopods from the West Range Limestone of Nevada: Jour. Paleontology, v. 43, no. 6, p. 1351-1368, illus., tables, 1969.

The upper brachiopod fauna of the formation, the *Cleiothyridina reticulata* fauna, contains eight species, of which *Parapugnax bactrianense* and *Crurithyris fissa* are new. The fauna is lower Famennian, intermediate between the *Cyrtospirifer* fauna of Merriam (1940) and the middle Famennian fauna of the Trident Member of the

Three Forks Formation. It is the middle fauna of three Famennian brachiopod faunas in the western United States; these faunas are discussed. — REG

Johnson, J. G. *See* Boucot, Arthur J. 06911

Johnson, J. Harlan. *See* Achauer, C. W. 07017

06921 **Johnson, J. Peter, Jr.** Late glacial origin of the Sandbanks, Webb Bay, Labrador: Canadian Geographer, v. 13, no. 2, p. 99-112, illus., 1969.

Phases of deglaciation of the Sandbanks, a terraced complex of glaciofluvial and glaciomarine deposits, are described. The first began with the appearance of local hills over 700 feet high above the ice sheet and was characterized by disintegration of two ice sheets. During Phase 2, the first and highest ice-dammed lake formed. Eastward ice marginal flow continued into Phase 3, when a large system of kame terraces, altitude 360 feet, formed beside the receding ice, leading to lower ice-marginal lakes. Phase 4 was dominated by construction of a more extensive system of kame terraces 100 feet lower than those of Phase 3. In Phase 5, meltwater from ice and runoff from deglaciated highlands filled a marginal lake, altitude 230 feet, which may have contributed to Port Danvers Run. In Phase 6, eustatically rising sea level was able to reach part of the Sandbanks; a terrace at 135 feet is the upper marine limit. — ESL

Jones, Blair F. *See* Hardie, Lawrence. 06726

Jones, Blair F. *See* Rooney, Thomas P. 07028

06505 **Jones, R. W.; Ross, S. H.** Moscow basin ground water problem — "How long will the water last?", *in* Engineering geology and soils engineering symposium, 7th Ann., Moscow, Idaho, 1969, Proc.: Boise, Idaho, Idaho Dept. Highways, p. 62-83, illus., 1969.

The amount of water in usable storage in the Moscow (Idaho) basin in 1965 and water that will remain in usable storage after satisfying predicted demands until the year 2000 is predicted on the basis of model studies, for a range of values of aquifer constants. Results are presented in graphs. — DBV

06905 **Jones, S. J.; Glen, J. W.** The mechanical properties of single crystals of pure ice [with French and German abs.]: Jour. Glaciology, v. 8, no. 54, p. 463-473, illus., tables, 1969.

Results obtained from tensile and compressive tests on pure ice single crystals at various temperatures down to -90°C are reported. At -50°C tensile creep tests give a continually increasing creep rate until fracture, as observed at higher temperatures. The stress dependence of the strain-rate is discussed. Fracture stress increases with decreasing temperature. Results from constant strain-rate compressive tests are compared with theoretical curves computed from Johnston's (1962) theory of dislocation multiplication. A dislocation velocity of the order of 0.5×10^{-6} m s^{-1} is deduced for ice at -50°C. — Authors' abstract

06514 **Jones, Thomas A.** Skewness and kurtosis as criteria of normality in observed frequency distributions: Jour. Sed. Petrology, v. 39, no. 4, p. 1622-1627, tables, 1969.

Moment measures are widely used to describe the properties of samples. The third and fourth moment, descriptors of skewness and kurtosis, may be used to test the hypothesis that the sample came from a normal distribution. This paper uses a Monte Carlo method to devise tables for this purpose. The approach involves repeated sampling from a normal population to determine the percentage points of the distribution of the estimators of skewness and kurtosis. The tables are arranged to indicate the limiting values of skewness and kurtosis that are acceptable without rejecting the hypothesis that the population is normal. — Author's abstract

06527 **Jones, Thomas A.** Determination of *n* in weight frequency data: Jour. Sed. Petrology, v. 39, no. 4, p. 1473-1476, illus., table, 1969.

Statistical analysis of particle size data is limited when one uses sieve-derived weight frequency data, inasmuch as there is no well-defined sample "size" associated with the total sample. However, the smallest measurable (reproducible) weight-unit used in the technique may be considered as a basic unit for weight frequency. On this basis, the sample size is defined by the total number of such weight units in the sample. Thus, if the sieve fractions are weighed to the nearest 0.05 gram, the sample size is found by dividing the total sample weight by 0.05 gram. A numerical example lends support to the concept that the population units may be advantageously defined as aggregates of grains, rather than as individual grains, in size frequency analysis. — Author's abstract

Jongebloed, Willem L. *See* **Bé, Allan W. H. 06432**

06398 **Judd, William R.** What is rock mechanics?: Geotimes, v. 14, no. 9, p. 11-15, illus., 1969.

The science of rock mechanics appeared in response to an increasing demand for quantitative answers to rock behavior; this engineering science now has reached the stage where we have developed numerous techniques to measure various performance parameters of rock. Voluminous experimental data are available, but only limited data have been obtained on prototype behavior, and new laws of behavior are desperately needed. Our findings to date have resulted in greater safety in structures that must interact with rock, but we still must seek methods of measurement and laws of behavior that will permit us to increase the efficiency and economy of such designs without a consequent decrease in safety. — *from* Author's summary

06589 **Jumikis, Alfreds R.** Theoretical soil mechanics, with practical applications to soil mechanics and foundation engineering: New York and London, Van Nostrand Reinhold Co., 432 p., illus., tables, 1969.

This introduction to theoretical soil mechanics is designed for graduate and postgraduate students, researchers, and consultants and civil engineers in practice. The four parts of the book are: (1) stresses — stress and stress conditions, stress component relations, theory of elasticity equations in two-dimensional problems in orthogonal, polar, and cylindrical coordinates; (2) stress distribution — stress components and rectangular, strip, circular, and other loading systems; (3) civil engineering applications of stress components — critical condition at edge of foundation, stress trajectories and isoclines, pressure along rupture surface, Prandtl's theory, experimental soil mechanics; and (4) vibration problems in soil. — MCM

06427 **Juo, A. S. R.; White, J. L.** Orientation of the dipole moments of hydroxyl groups in oxidized and unoxidized biotite: Science, v. 165, no. 3895, p. 804-805, illus., 1969.

Observations of the infrared absorption bands attributed to the stretching vibrations of hydroxyl groups in biotite containing predominantly ferrous iron show that the dipole moments of the hydroxyls associated with ferrous iron are oriented perpendicular to the cleavage plane of the lattice. Oxidation in the biotite from ferrous iron to ferric iron results in the disappearance of the infrared absorption bands due to the hydroxyls associated with ferrous iron. The dipole moments of the hydroxyls associated with ferric iron in the oxidized biotite have been shown to be in an inclined position with respect to the cleavage plane. Experiments confirm the hypothesis of Barshad and Kishk [1968] regarding the effect of oxidation on the replaceability of interlayer potassium ions in biotite by ammonium ions. — Authors' abstract

06463 **Kamb, Barclay.** Structural studies of the high-pressure forms of ice, *in* Crystal structure at high pressure — Symposium, Seattle, Wash., 1969: Am. Cryst. Assoc. Trans., v. 5, p. 61-80, illus., tables, 1969.

Hydrogen bonding in ordinary ice is almost perfectly tetrahedral. In ice subjected to high pressure, structures of dense phases will indicate whether this typical bonding is modified or even eliminated. The present discussion emphasizes experimental techniques and problems in crystallographic study of high-pressure phases generally, and notes recent developments. At pressures below 23 kb, ten known phases are accessible; the H_2O system has been explored to 170 kb with no indications of addi-

tional phases. Most of the tabulated crystallographic results on dense phases were obtained with quenched samples, by methods discussed particularly in relation to obtaining such information under pressure. Study of any nonquenchable phases may require high-pressure diffraction techniques, such as single-crystal X-ray or, better yet, neutron diffraction. — GDC

Karner, F. R. *See* Groenewold, G. H. 06976

06990 **Karner, F. R.** Two generations of sphene in the Tunk Lake granite, southeastern Maine: North Dakota Acad. Sci. Proc. 1968, v. 22, p. 96-103, illus., tables, 1969.

Preliminary study of the accessory mineral sphene, $CaTi(SiO_4)(O,OH,F)$, in the Tunk Lake granite, southeastern Maine, indicates that it formed in two different environments of crystallization. In the outer part of the concentrically zoned granite body which is exposed over a circular area of 70 square miles, sphene occurs as euhedral crystals which appear to have formed early in the crystallization history of the rock. In the center of the body, sphene occurs as irregular masses which, along with biotite, secondarily replace primary hornblende, suggesting an origin by late-state recrystallization. The two occurrences indicate the complexity of accessory-mineral formation and the dependence upon other mineral reactions both during magmatic crystallization and late recrystallization. — Author's abstract

06415 **Kashef, Abdel-Aziz I.** Ground-water movement toward artificial cuts: Water Resources Research, v. 5, no. 5, p. 1032-1040, illus., tables, 1969.

Artificial cuts, such as open channels and highway cuts, produce an imbalance in the original ground-water system. The developed drawdowns due to these cuts under the condition of saturated steady flow are studied theoretically by analyzing the seepage through trapezoidal sections of earth entailing the complexity of the free surface. The procedure is then extended to actual cases of extensive aquifers where such cuts exist. The proposed method is compared with some of the available rigorous mathematical solutions, such as those given by Falkovich, Mikhailov, Meletchenko, Pavlovsky, and Polubarinova-Kochina. The proposed method is simpler in its application and also gives a complete solution for the free surface, the discharge face, the rate of flow, and the hydropotential distribution within the affected region, whereas the rigorous methods are planned essentially for the solution of the free surface only. — Author's abstract

06906 **Keeler, Charles M.** The growth of bonds and the increase of mechanical strength in a dry seasonal snow-pack [with French and German abs.]: Jour. Glaciology, v. 8, no. 54, p. 441-450, illus., tables, 1969.

[The rate of change in mechanical strength of a snow cover is a parameter of considerable usefulness in glaciological engineering.] Simultaneous measurements were made of both strength and structural properties of a dry, seasonal snow-pack. Densities of snow studied ranged from 126 to 407 kg m^{-3}. Mechanical strength of this snow as determined by *in situ* shear-wave test and a centrifugal tensile test increases exponentially with the increase in size of intergranular sands. Bonding increases at a rate substantially greater than that predicted by the classical sintering equations. It is suggested that this is due to the wide variety of stresses present in snow with these relatively low densities. — *from* Author's abstract

Keeley, Jack W. *See* Scalf, Marion R. 06414

Keil, Klaus. *See* Snetsinger, Kenneth G. 06478

06489 **Kelly, W. L.** Instrumentation methods and results for the John Day Dam relocation, *in* Engineering geology and soils engineering symposium, 7th Ann., Moscow, Idaho, 1969, Proc.: Boise, Idaho, Idaho Dept. Highways, p. 144-158, illus., 1969.

In connection with relocation of the John Day Dam, three types of measurements were required — for vertical movements, horizontal movements, and ground water elevations. The types and details of the instruments used are described. The program

for the John Day Dam relocation has provided excellent information on the desired measurements. Movement diagrams have been obtained for critical areas; rates of movement can be monitored quite precisely. Plotting variables against movement provides valuable information as to the effects of these variables. If rapid accelerations are detected in the movement graphs, it is anticipated that preventive work can be accomplished or at least a warning can be given before a failure occurs. — DBV

Kempton, J. P. *See* Kim, S. M. 06406

06438 **Kent, Harry C.** *Praebulimina prolixa elongata*, new name for *Praebulimina prolixa longa* Kent, 1967: Jour. Paleontology, v. 43, no. 6, p. 1441, 1969.

The new name *Praebulimina prolixa elongata* for a Cretaceous foraminifer from Colorado, is proposed to replace *prolixa longa* Kent, which is preoccupied by *Bulimina* (*Praebulimina*,) *prolixa longa* deKlasz, Magne and Rerat, 1963. — RCD

Key, M. H. *See* Clark, M. C. 07048

06595 **Keys, W. Scott; Boulogne, A. R.** Well logging with Californium-252: Log Analyst, v. 10, no. 6, p. 11-24, illus., tables, 1969.

Californium-252, an isotopic neutron source only recently available for experimental well logging, has 300 times the emission rate of any other one-curie radioisotopic source; also very small physical size, low gamma and heat emission, and relatively low cost. The nuclear and physical characteristics of a fabricated 50-millicurie Cf-252 source and some of the health physics aspects of its use are discussed. Used to make epithermal neutron logs, which are compared with logs made with plutonium-beryllium and americum-beryllium sources in the same well, the high neutron flux from Cf-252 permitted longer than usual spacing while maintaining a high count rate and excellent sensitivity. In addition, continuous activation logs were made using a spacing of 5.5 feet from source to detector. This new technique may provide a log more closely related to clay content than the natural gamma log. — *from* Authors' abstract

Khudoley, K. M. *See* Meyerhoff, A. A. 07032

06461 **Kiefer, Ralph W.** Airphoto interpretation of flood plain soils: Am. Soc. Civil Engineers Proc., v. 95, paper 6819, Jour. Surveying and Mapping Div., no. SU1, p. 49-70, illus., 1969.

Urban planners and developers are giving increasing emphasis to the problems of land use on flood plains. In order to plan effectively, both the distribution of soil types on the flood plain and the flood frequency must be known. The use of aerial photographic interpretation techniques to estimate the soil conditions is described. New techniques of airborne remote sensing can also prove useful in flood plain soil studies. Imaging sensors such as infrared and color photography, infrared imagery, and side-looking airborne radar, as well as some nonimaging sensors, are described. In order to plan successfully for land use on flood plains, all available planning tools must be utilized; much valuable information about flood plain soils can be obtained through aerial photographic interpretation studies. — *from* Author's abstract

06406 **Kim, S. M.; Ruch, R. R.; Kempton, J. P.** Radiocarbon dating at the Illinois State Geological Survey: Illinois Geol. Survey Environmental Geology Note 28, 19 p., illus., tables, 1969.

The radiocarbon dating laboratory of the Illinois State Geological Survey, established in Sept. 1968, processes samples submitted by members of the staff or by other state agencies, and selected samples from other sources, especially when pertinent to Illinois problems. The theory and technique are reviewed, and problems common to all radiocarbon dating laboratories are discussed. Specific procedures and facilities in use at the Survey laboratory are emphasized. One of the first projects of the ISGS laboratory was to determine dates for two organic silts which field evidence indicated might restrict the extent of the Woodfordian Green River Lobe; dates determined

supported this evidence. Another project developed when mastodon remains were excavated on the edge of Urbana. — ESL

Kirkham, Don. *See* Srinilta, Sam-arng. 07034

Kishk, Fawzy M. *See* Barshad, Isaac. 06972

Kisvarsanyi, Eva B. *See* Wagner, Richard E. 06428

06879 **Kittrick, J. A.** Soil minerals in the Al_2O_3-SiO_2-H_2O system and a theory of their formation [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 17, no. 3, p. 157-167, illus., 1969.

Discussion of the stabilities of individual minerals includes amorphous silica and quartz, aluminum hydroxide and oxyhydrates, kaolinite, and montmorillonite. Having established stabilities of common soil minerals the next step is to construct a stability diagram. The one used here is for amorphous silica, montmorillonite, kaolinite, and gibbsite. Application of the diagram to weathering includes phase relations, ion activity relations, aluminum hydroxide potential as the dependent and H_4SiO_4 as the independent variable, and kinetics and weathering intensity. — ESL

Klaus, Jacob. *See* Molnar, Peter. 06983

Kleinkopf, M. Dean. *See* Rocky Mtn. Assoc. Geologists. 06970

Kling, S. A. *See* Heezen, B. C. 06736

Knight, A. L. *See* LaMoreaux, P. E. 06649

06582 **Knight, David C.** Meteors and meteorites — An introduction to meteoritics: New York, N. Y., Franklin Watts, 91 p., illus., 1969.

This well illustrated book contains sections on: an introduction to meteoritics; the terms meteoroid, meteor, and meteoritic; meteors and meteor phenomena; meteoroids in space; meteoroids and their orbits; meteor showers, swarms, and streams; meteorites; meteorite falls; and the ultimate origin of meteoritic material. — MCM

Knostman, Richard W. *See* Bannister, D'Arcy. 06680

Koch, Donald L. *See* Dorheim, Fred H. 06929

Kolb, Charles R. *See* Krinitzsky, E. L. 06491

Konnert, Judith A. *See* Clark, Joan R. 06760

Koucky, Frank L. *See* Drafall, Larry E. 06788

Krasheninnikov, V. *See* Heezen, B. C. 06736

06491 **Krinitzsky, E. L.; Kolb, Charles R.** Geological influences on the stability of clay shale slopes, *in* Engineering geology and soils engineering symposium, 7th Ann., Moscow, Idaho, 1969, Proc.: Boise, Idaho, Idaho Dept. Highways, p. 160-175, illus., 1969.

The stability of clay shale slopes is determined by a group of identifiable contributing factors, operating in groups. The major factors are lithology, structure, and ground water; lesser factors are associated with weathering, stages of structural relaxation, local topography and erosion, and detail of rock fabric. The importance of individual factors varies from place to place, sometimes over short distances. Examples are given. — DBV

06484 **Krizek, R. J.; Franklin, A. G.** Nonlinear dynamic response of soft clay, *in* Vibration effects of earthquakes on soils and foundations — ASTM, 71st Ann. Mtg., San Fran-

cisco, 1968, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 450, p. 96-114, illus., 1969.

About 40 controlled-deformation, torsional shear tests in sinusoidal oscillation were performed on Georgia kaolin at moisture contents ranging from slightly below to considerably above the liquid limit. The results are expressed in terms of complex viscoelastic response parameters. The modulus of the complex modulus was found to vary exponentially with the moisture content and to vary as the -1.3 power of the strain amplitude. The phase lag between stress and strain had no discernible dependence upon moisture content for those above the liquid limit, but varied as the 0.4 power of the strain amplitude. Despite the marked nonlinearity of the material, the calculations of energy dissipation according to viscoelastic relations agrees comparatively well with the observed data. — *from* Authors' abstract

06485 **Krizek, R. J.; Franklin, A. G.** Torsional shear testing technique for dynamic properties of clay, *in* Vibration effects of earthquakes on soils and foundations — ASTM, 71st Ann. Mtg., San Francisco, 1968, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 450, p. 115-137, illus., 1969.

The basic device used for the testing is a modified Weissenberg rheogoniometer. The deformations and forces are readily converted to shear stresses and shear strains; the time differences between corresponding points are also recorded. Two types of tests are common. In one case, the frequency is maintained constant while the deformation amplitude is varied, while in the other case, the reverse is true. The data allow the evaluation of the effect of stress history, the degree of nonlinearity in the stress-strain response, and the extent to which the presently available theories, such as linear viscoelasticity, can be used to interpret the mechanical behavior. — *from* Authors' abstract

Krouse, H. R. *See* Macpherson, D. S. 06565

Krupička, J. *See* Burwash, R. A. 06693

Krupička, J. *See* Burwash, R. A. 06862

06920 **Kudo, Akira.** Radioactivity transport in water-interaction between flowing water and bed sediment [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1727B, 1969.

06516 **Kuenen, Ph. H.** Origin of quartz silt: Jour. Sed. Petrology, v. 39, no. 4, p. 1631-1633, illus., 1969.

Eolian action does not produce quartz particles between 20 and 50 microns in mass, either by abrasion of larger grains or by spalling of chips in that size range. Aqueous spalling is insignificant compared to disintegration of phyllite or similar material and of coarser crystalline rocks. Glacial action is particularly important. — Author's abstract

Kullerud, Gunnar. *See* Craig, James R. 06769

06470 **Kumazawa, Mineo.** The elastic constants of single-crystal orthopyroxene: Jour. Geophys. Research, v. 74, no. 25, p. 5973-5980, illus., tables, 1969.

The elastic constants of a very small orthopyroxene gem of the bronzite variety were measured by the pulse superposition method. The adiabatic stiffness constants in Mb at room temperature and 1 atm pressure are given. Using the Voigt-Reuss-Hill average, the dilational wave velocity is 7.85 kmps, shear wave velocity is 4.76 kmps, bulk modulus is 1.050 Mb, rigidity is 0.755 Mb, and Poisson's ratio is 0.21. In contrast with the properties of clinopyroxenes, the a axis in this crystal is elastically the most stiff direction, showing the maximum dilational velocity and minimum linear compressibility. The maximum velocity anisotropy of dilational waves is 1.26 kmps, or 17 percent, which is comparable to 18 percent for olivine. — *from* Author's abstract

Kummer, John T. *See* Bockheim, James G. 06385

00010 **Lachenbruch, Arthur H.** Some estimates of the thermal effects of a heated pipeline in permafrost: U.S. Geol. Survey Circ. 632, 23 p., illus., tables, 1970.

An oil pipeline south from the Arctic slope of Alaska would thaw surrounding permafrost, but cause no special problems where ice content is not high. Under adverse conditions, effects on environment could be disruptive, and security of pipe endangered. A few basic principles are applied in simplified models of permafrost to identify controlling conditions, and range of physical properties for which these effects may cause problems. In sediments with excessive ice and very low permeability, free water generating faster than it filters to the surface could produce a semiliquid slurry, then a mudflow displacing the pipe. Shearing stresses on pipe may result from differential settling in ice-wedge networks, or be caused by earthquakes in seismic zones. Subtle changes in properties are difficult to detect in advance. A deepening and widening trench over a pipeline in saturated sediments could alter drainage patterns and create erosion problems. — GDC

Lahoud, J. A. *See* Murphy, J. R. 06890

06947 **Lajtai, E. Z.** Shear strength of weakness planes in rock: Internat. Jour. Rock Mechanics and Mining Sci., v. 6, no. 5, p. 499-515, illus., 1969.

The influence of a single plane of weakness on shear strength in direct shear loading is examined. It is shown that total shear strength is determined by fundamental shear strength (cohesion) and internal friction in solid bridges and by joint friction along the separated parts of the weakness plane. If neither of the frictional resistances is mobilized before total loss of cohesion occurs, maximum strength is controlled solely by the tensile strength of the solid bridges. A criterion of failure in direct shear is developed for this case and the theory is compared with results of model tests. It is also shown that deformation requirements for the full realization of joint and internal friction are generally different and hence the two types of frictional resistances should be treated separately in evaluating total shear strength. — Author's abstract

06654 **Lal, R. K.** Retrogression of cordierite to kyanite and andalusite at Fishtail Lake, Ontario, Canada: Mineralog. Mag., v. 37, no. 288, p. 466-471, illus., table, 1969.

Cordierite from the Fishtail Lake shows textural evidence indicating retrogression to kyanite, andalusite, and coarse flakes of chlorite. This is consistent with experimental data on the stability of cordierite and may be expected to be limited to potash-deficient rocks, such as the cordierite-garnet-gedrite bearing gneisses of the area. In common potash-bearing pelitic rocks, retrogression of cordierite results in the formation of sericite and chlorite. In gneisses containing sillimanite and cordierite, the breakdown of the cordierite in this way results in the association of the three aluminosilicates (kyanite, andalusite, and sillimanite) in the same rock. The association of kyanite-andalusite in equilibrium probably suggests the retrogression of the cordierite took place close to the univariant line of kyanite-andalusite. — *from* Author's abstract

06649 **LaMoreaux, P. E.; Knight, A. L.; Copeland, C. W.; McCain, J. F.; Clarke, O. M., Jr.; Daniel, T. W., Jr.; Szabo, M. W.; Smith, W. E.; Moore, D. B.; Tucker, W. E.** Mineral, water and energy resources of Wilcox County, Alabama: Alabama Geol. Survey Inf. Ser. 40, 49 p., illus., tables, 1969.

Sections of this popular account by the various authors are: introduction, topography, geology, water resources, mineral resources, energy, and history. Twenty selected references are listed. Basic data appended includes records of selected wells and springs; geologic units and their water-bearing characteristics; chemical analyses of water from selected streams, wells, and springs; general grain-size frequency distribution of sand and gravel deposits; chemical analyses of phosphatic material and of Clayton Formation; and proximate analyses of lignite samples. — MCM

Lamport, M. B. *See* Langenheim, R. L., Jr. 07025

Landon, Ronald A. *See* Hughes, George M. 07019

06909 **Landsberg, H. E.; Mieghem, J. van.** (editors). Advances in geophysics, V. 13: New York and London, Academic Press, 267 p., illus., tables, 1969.

These review papers cover advances in airborne geophysical methods and atmospheric studies (lidar, ball lightning, energetics, gaseous ions). Some of the papers were themes at the 14th General Assembly of the International Union of Geodesy and Geophysics in 1967. The paper by P. Hood and S. H. Ward on airborne geophysical methods is cited separately. — MCM

07025 **Langenheim, R. L., Jr.; Lamport, M. B.; Winter, J. K.** Geology, stratigraphy and structure of the West Range, Lincoln County, Nevada: Earth Sci. Bull., v. 2, no. 3, p. 27-36, illus., 1969.

More refined stratigraphic subdivision within Westgate's (Westgate and Knopf, 1932) Silverhorn Dolomite and Tertiary(?) lava and associated tuffs has aided more detailed mapping of the complex fault pattern in the West Range. In addition, rocks above Westgate's Bristol Range Thrust have been determined to consist of more than 1500 feet of brecciated early Paleozoic rock with minor interlayered volcanic sandstone. The following sequence of events appears indicated: deposition of Sevy Dolomite, Simonson Dolomite, Guilmette Formation, West Range and Joana Limestones; erosion and uplift followed by emplacement of Oligocene Needles Range Formation; extensive normal faulting; emplacement of breccia sequence and intercalated sandstone; Basin and Range faulting responsible for present relief; deposition of Panaca Formation(?). —*from* Authors' abstract

07047 **Langleben, M. P.** Attenuation of sound in sea ice, 10-500 kHz [with French and German abs.]: Jour. Glaciology, v. 8, no. 54, p. 399-406, illus., 1969.

Measurements of the attenuation of acoustic waves in sea ice at frequencies f between 10 kHz and 500 kHz have been made on the ice cover at Tanquary Fiord, Ellesmere Island. A horizontal transmission path at a depth of 4 feet, midway between the top and bottom surfaces of the ice cover, was used at ranges varying from 25 to 4 feet between piezoelectric transducers immersed in oil-filled boreholes. The attenuation coefficient α was found to fit the equation $\alpha = c_1 f + c_2 f^4$ with $c_1 = 4.45 \times 10^{-2}$ db m^{-1} kHz^{-1}, and $c_2 = 2.18 \times 10^{10}$ db m^{-1} kHz^{-4}. Over the frequency band covered, the linear term was predominant and the Rayleigh scattering term relatively insignificant. — *from* Author's abstract

07040 **Langmuir, Donald.** Iron in ground waters of the Magothy and Raritan Formations in Camden and Burlington Counties, New Jersey: New Jersey Div. Water Policy and Supply Water Resources Circ. 19, 49 p., illus., tables, 1969.

Most well waters here yield total iron concentrations of over 0.3 mg per l; from samples of 185 wells, four water-quality zones are defined. Ground water in the northern three is of calcium-carbonate type, and is sodium-replaced in zone 4. In zone 1, oxygenated and pure, pH values are 5.0 to 6.0 and iron<0.5 mg/l; these values are higher in zone 2 near Philadelphia, Pa.; downdip to the south, in zone 3, iron decreases to less than 0.05 mg/l at a pH of 8.0, due to exchange reactions which may also be responsible for less than 0.3 mg/l in zone 4. Heavy pumpage near Philadelphia has induced northerly flow of ground water in zone 3; then shallow wells in Camden County drew it downdip from outcrop areas; deeper wells in the same area probably induce significant vertical leakage through overlying formations. Adjustment of ground water to seasonal changes may cause local movements, with corresponding changes in iron content. — *from* Author's abstract

Larson, Richard R. *See* Czamanske, Gerald K. 06445

Larson, Roger L. *See* Spiess, Fred N. 06577

06998 **Laughlin, A. William.** Excess radiogenic argon in pegmatite minerals: Jour. Geophys. Research, v. 74, no. 27, p. 6684-6690, illus., tables, 1969.

This study demonstrates the unreliability of plagioclase and spodumene from the plutonic environment for K-Ar dating. Data from this work and from the literature in-

dicate that in eight out of twelve pegmatites, plagioclase yielded K-Ar apparent ages older than the cogenetic micas. Spodumene samples from three pegmatites gave erratic results: one approximating the true age, one too young, and one too old. The quantities of excess Ar-40 incorporated by the plagioclase are not constant but increase with the true age of the sample in accordance with the previously recognized excess inert gas age effect. — Author's abstract

Laurent, Jean-Louis. *See* Guedelia, Daniel. 00072

06378 **Lee, K. L.; Fitton, J. A.** Factors affecting the cyclic loading strength of soil, *in* Vibration effects of earthquakes on soils and foundations — ASTM, 71st Ann. Mtg., San Francisco, 1968, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 450, p. 71-95, illus., tables, 1969.

Pulsating loading triaxial tests were performed on saturated samples of soil to determine the effect of grain size, grain-size distribution, and grain shape on the strength of soil under simulated earthquake loading conditions. Comparing soils tested at the same relative density and confining pressure it was found that fine silty sands were the weakest, with 3/4-in. gravel being two times stronger and compacted clay being up to three times stronger. The effect of grain-size distribution and grain shape was considerably less significant than the grain size. — Authors' abstract

Lee, W. H. K. *See* Eaton, J. P. 06793

Leveen, Larry S. *See* Fahnestock, Robert K. 06820

Levin, Harold L. *See* Brice, James C. 06591

Levorson, Calvin O. *See* Stremple, Harrell L. 06897

06678 **Lin, H. C.; Foster, W. R.** Studies in the system BaO-Al_2O_3-SiO_2 — [Pt.] 3, The binary system sanbornite-celsian: Mineralog. Mag., v. 37, no. 288, p. 459-465, illus., table, 1969.

The system sanbornite-celsian has been investigated by the quenching method and the results compared with earlier studies. The system is essentially a simple binary eutectic system with little or no solid solution. The eutectic is located at a composition of 69 percent sanbornite and 31 percent celsian (by weight) and at a temperature of 1227 ± 3°C. No evidence for substantial solid solution of celsian to sanbornite, as reported in previous work, was found. Paracelsian, a naturally occurring polymorph of celsian, was not encountered in the study. — Authors' abstract

Lisitzin, A. P. *See* Heezen, B. C. 06736

06922 **Lister, C. R. B.** Some problems in digital heat-flow measurement: Bull. Volcanol., v. 33, no. 1, p. 299-310, illus., 1969.

Heat flow measurements in the northeastern Pacific have recently been made with a new temperature recorder which digitizes sensor resistance directly. The device is described. Problems encountered in fully utilizing the resolution available (the sensitivity of the instrument is 10^{-5}) are analyzed. — DBV

00057 **Livneh, Moshe.** Prediction of swelling pressure of clays — Discussion [of paper 6358, by A. Komornik and D. David, 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM 1, p. 323-324, table, 1970.

Assuming that the specific gravity of the clay material is 2.8, equation 6 is reduced to a more general form and shows that the swell pressure decreases with the growth of the initial porosity and moisture content and increases with the plasticity. A comparison is made with some Israeli clays. — ESL

06573 **Lliboutry, L.** Sea-floor spreading, continental drift and lithosphere sinking with an asthenosphere at melting point: Jour. Geophys. Research, v. 74, no. 27, p. 6525-6540, illus., tables, 1969.

Models of global tectonics are criticized and a new model is put forward. Assuming the asthenosphere to be entirely at melting point temperature, it is suggested that lithospheric plates are pushed upslope by the ridges, where a deep crack filled with compressed magma persists in spite of a continuous symmetrical solidification on the walls. Underneath, a counterflow involves the lower asthenosphere, and the unconformity of the geoid undulations with the existing convective cells is explained by a time lag in the adjustment of this counterflow. It is shown that the counterflow of the asthenosphere must exactly balance the discharge of the lithosphere over it. A new model of the sinks of the lithosphere is put forward that assumes the existence of vertical faults within the sinking plate. — GV

06393 **Lo, K. Y.** The pore pressure-strain relationship of normally consolidated undisturbed clays — Pt. 2, Experimental investigation and practical applications [with French abs.]: Canadian Geotech. Jour., v. 6, no. 4, p. 395-412, 1969.

Experimental results on normally-consolidated undisturbed clays of various sensitivities are presented and analyzed using the approach developed in Pt. 1. Both for isotropically and anisotropically consolidated samples, pore pressure ratio-strain relation is independent of magnitude of consolidation pressures, time of sustained stress, time of consolidation and intrinsic anisotropy under both plane strain and axially-symmetric stress conditions. Effect of intermediate principal stress may be taken easily into account to estimate pore pressure set up under plane strain condition from results of laboratory triaxial tests. The effect of strain rate was small for clays tested, and becomes insignificant at large strains. The relevance of each of these conclusions in relation to practical problems are discussed. The use of the pore pressure-strain approach in practice, and for some classes of field problems are indicated. — *from* Author's abstract

06403 **Lo, K. Y.** The pore pressure-strain relationship of normally consolidated undisturbed clays — Pt. 1, Theoretical considerations [with French abs.]: Canadian Geotech. Jour., v. 6, no. 4, p. 383-394, 1969.

This paper presents a critical review of the current theories of predicting pore pressures in saturated clays. These theories are generalized and examined, and their limitations discussed. It is shown mathematically that the pore pressure induced by shear may be expressed as a sole function of major principal strain, and this approach eliminates the anomalies inherent in the "stress theories" for pore pressure. A hypothesis is also developed to provide a possible mechanism of pore pressure set up in undisturbed normally-consolidated clays. — Author's abstract

Lodding, William. *See* Enright, Richard C. 06797

Logan, J. M. *See* Friedman, M. 00069

00044 **Londe, Pierre; Bigler, Gaston; Vormeringer, Raymond.** Stability of rock slopes, a three-dimensional study — Errata [to paper 6363, 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM 1, p. 329-330, 1970.

Sixteen errors to paper 6363 (ibid., v. 95, no. SM 1, p. 235-262, 1969) are listed. — ESL

Loomis, S. *See* Ewing, K. 06698

LoPinto, Victor J. *See* Bigham, Robert E. 00054

Lougeay, R. *See* Ewing, K. 06698

Louisnathan, S. J. *See* Moore, P. B. 06676

Loveridge, W. D. *See* Wanless, R. K. 06964

06408 **Lovett, William T.** Meet Mr. EROS — Our space-age dowser: Ground Water Age, v. 4, no. 3, p. 28-35, illus., 1969.

The ERTS (Earth Resources Technical Satellites) program, of EROS, will provide vital information for many different sciences, including mineral exploration, plotting the flow of sediments and pollutants, and discovery of ground water. Three return-beam TV cameras will take pictures in the blue-green, red, and near infrared portions of the spectrum. Uses of present spacecraft pictures described include hydrology of playa lakes in the Texas High Plains. The ERTS satellite will be able to photograph the same area every 17 days. It will also aid estuary studies, and studies of the disposition of ice and snow in the upper Columbia River basin to determine the best times to store water. Discovery of ground-water resources in Massachusetts, Hawaii, and Florida were aided by infrared imagery. — ESL

00033 **Lum, Daniel; Stearns, Harold T.** Pleistocene stratigraphy and eustatic history based on cores at Waimanalo, Oahu, Hawaii: Geol. Soc. America Bull., v. 81, no. 1, p. 1-16, illus., 1970.

Eight drill holes in the Waimanalo coastal plain of Oahu yield evidence of a series of eustatic risings and fallings of sea level during Pleistocene time. Assuming correlations between major regressions and glacial stages, four stages have been recognized. Sediments penetrated include reef limestones, dune sands and terrigenous deposits. Stratigraphic evidence indicates that the Koolau Volcano of Oahu ceased its activity, was deeply incised by amphitheater-headed valleys, which were subsequently drowned and partly filled with sediments during late Tertiary time. — *from* Authors' abstract

06646 **Lumbers, S. B.** Geology of Limerick and Tudor Townships, Hastings County: Ontario Dept. Mines Geol. Rept. 67, 110 p., illus., tables, geol. maps, 1969.

The townships, near the southwest border of the Grenville Province of the Precambrian Shield, are underlain by a Proterozoic metavolcanic-metasedimentary sequence 27,000 feet thick, regionally metamorphosed to greenschist and almandite amphibolite facies. Two main divisions are recognized, a metavolcanic group divided into five formations, and an extensive unit rich in carbonate metasediments. The sequence is intruded by two groups of stocks, an early sodic and a late potassic, the oldest being emplaced before culmination of metamorphism. A small outlier of Middle Ordovician is exposed in the southeast corner of Tudor Township; calcite and quartz fissure veins younger than this are related to northwest trending faults. Rusty-weathering schist zones of hydrothermal origin are common in deformed rock; polymetallic mineralization is present and associations are described. — *from* Author's abstract

Lumsden, W. W. *See* Moores, E. M. 00018

06645 **Lund, John W.; Hendrickson, Larry G.** The use of volcanic cinders for low class roads, *in* Engineering geology and soils engineering symposium, 7th Ann., Moscow, Idaho, 1969, Proc.: Boise, Idaho, Idaho Dept. Highways, p. 271-289, illus., 1969.

This paper reviews existing uses of volcanic cinders for low-class-road construction, especially in the form of a wearing surface. Information is given concerning the properties of volcanic cinders, the types of deposits, their distribution throughout the world, and their use in other countries. Current usage in State and Federal agencies is discussed together with results and recommendations. Special emphasis is given to the experiences in central Oregon and northern California. A summary is given of present preferred cinder types with acceptable road construction procedure. A current U.S. Forest Service study, including a low-class-road rating system related to laboratory tests and field quality control of volcanic cinders, is outlined. — DBV

Luyendyk, Bruce P. *See* Spiess, Fred N. 06577

06895 **Lynch, Robert D.** Response spectra for Pahute Mesa nuclear tests: Seismol. Soc. America Bull., v. 59, no. 6, p. 2295-2309, illus., tables, 1969.

Empirical equations for the prediction of pseudo-relative velocity response spectrums (PSRV) are obtained from ground motions recorded at 64 seismic stations

from 11 nuclear events detonated on Pahute Mesa at the Nevada Test Site (NTS). The spectrums are related to the yield of the nuclear device and the distance between the source and receiver by multiple regression analysis. Exponents on yield and distance are derived at 40 separate periods in the period range from 0.05 to 2.469 sec. Families of predicted mean PSRV curves are included to show the spectral development as a function of yield and distance. — Author's abstract

MacClintock, Paul. *See* Stewart, David P. 06683

07006 **MacFall, Russell P.** Gem hunter's guide — The complete handbook for the amateur collector of gem minerals (4th revised edition): New York, N. Y., Thomas Y. Crowell Co., 270 p., illus., tables, 1969; originally published 1951.

Sections in this book are titled: it's fun to hunt for gems, how to identify gem minerals, rock formations in which gems occur, how to hunt for gems, characteristics of important gem stone materials, gem materials in their full natural color, black light for your minerals, judging quality and value, collectors and collections, diamonds in the United States, pearls in the United States, directory and maps of gem-hunting locations, glossary, sources of information, and for further reading. — MCM

Machesky, L. *See* Woollard, G. P. 07022

06381 **Macintyre, Ian G.; Pilkey, Orrin H.** Preliminary comments on linear sand-surface features, Onslow Bay, North Carolina continental shelf — Problems in making detailed sea-floor observations: Maritime Sediments, v. 5, no. 1, p. 26-29, illus., 1969.

Data from a surface vessel are compared with those collected by divers to give a better understanding of sedimentary processes on the sea floor. Onslow Bay is subjected to a low rate of sedimentation because of protection by shoals and lack of large rivers discharging into it. North-south trending bands or patches (channels) of coarse calcareous sediments cut across finer less calcareous sands. Well-developed ripples trend at right angles to trend of the channels. Two hypotheses for formation of the coarse-grained bands are: areas of winnowing produced by channeling of bottom currents related to storm surge reflux; and finer, nearshore, "equilibrium" sediments are transgressing over coarser, relict shelf sediments influenced by intermittent bottom currents. Hurricane Abbey may have been the responsible event. Later turbulence from short-period waves destroys ripples in fine sand but coarser sediments are not disturbed. — ESL

06952 **Macintyre, R. M.; York, D.; Gittins, J.** The K-Ar characteristics of nepheline: Earth and Planetary Sci. Letters, v. 7, no. 2, p. 125-131, illus., tables, 1969.

The radiogenic argon-40 contents of several nephelines from the Grenville Province of the Canadian Shield have been determined using an MS10 mass spectrometer and their potassium contents measured by flame photometry. The calculated potassium-argon ages near 1 b.y. are never less than similar ages calculated for cogenetic minerals. Evidence is presented which seems to indicate that the ages are meaningful and consequently that nepheline is suitable for use in potassium-argon dating. — Authors' abstract

00058 **MacKay, Margaret R.** Lepidoptera in Cretaceous amber: Science, v. 167, no. 3917, p. 379-380, illus., 1970.

The discovery of the head capsule of a lepidopterous larva in Canadian amber of the Cretaceous period is the first fossil evidence of Lepidoptera before the Tertiary period. — Author's abstract

MacLachlan, James C. *See* Rocky Mtn. Assoc. Geologists. 06970

06481 **MacNeill, R. H.** Dating some Quaternary changes in sedimentation in the Tantramar Marsh of New Brunswick: Maritime Sediments, v. 5, no. 1, p. 1-2, illus., 1969.

During construction of a control dam near Sackville, sediments were excavated to bedrock, giving a good exposure; several deep cut-and-fill areas appeared. Wood was found at two levels in the filled channels, 25 feet and 22 feet below present marsh level. Radiocarbon ages were 3430 ± 110 and 3290 ± 100 yr B.P. The marsh area was one of very active erosion and deposition during the last several thousand years. The channel meandered considerably, and in each cut erosion appeared to reach bedrock indicating very rapid waters moving through the marsh. — ESL

06482 **MacNeill, R. H.** Some dates relating to the dating of the last major ice sheet in Nova Scotia: Maritime Sediments, v. 5, no. 1, p. 3, 1969.

Little direct evidence for the date of the beginning of the last major ice sheet in Nova Scotia has been revealed. In the writer's work mapping Pleistocene deposits, little organic material has been found, but dates have been determined for three samples, two related to the beginning of the ice sheet, and one which relates to the end. Carbon-14 dates for the beginning are 33700 ± 2300 and 33200 ± 2000 yr B.P. The closing of the Pleistocene was dated at 11670 ± 1700 yr B.P. — ESL

06565 **Macpherson, D. S.; Krouse, H. R.** O^{18}/O^{16} ratios in snow and ice of the Hubbard and Kaskawulsh Glaciers, *in* Icefield Ranges Research Project scientific results, V. 1 (V. C. Bushnell and R. H. Ragle, editors): New York,Am.Geog.Soc.,and Montreal, Quebec, Arctic Inst.North America, p. 63-73, illus., tables,reprinted 1969;originally published 1967.

This paper was first published *in* Isotope techniques in the hydrologic cycle — Symposium at the University of Illinois, 1965: Am. Geophys. Union Geophys. Mon. Ser., no. 11, p. 180-194, 1967. *See* Abstracts of North American Geology for November 1967. — MCM

07030 **MacTavish, John N.; Malone, Philip G.; Wells, Terry L.** RMAR — A reduced major axis regression program designed for paleontologic data, a correction [to 1968 paper]: Jour. Paleontology, v. 43, no. 6, p. 1443, 1969.

An important error in the program listing (Table 1), for the calculation of BREG, [ibid., v. 42, no. 4, p. 1076-1078] is herein rectified. The original paper was cited in Abstracts of North American Geology, May 1969. — VMJ

Macurda, Donald B., Jr. *See* Breimer, Albert. 06850

Mader, George G. *See* McCulloch, D. S. 06987

Madison, James A. *See* Condie, Kent C. 06442

06429 **Madsen, Ole S.** A note on the equation of ground-water flow: Water Resources Research, v. 5, no. 5, p. 1157-1158, 1969.

Since the paper by DeWiest (1966) the correct form of the storage coefficient has been discussed. Cooper (1966) pointed out an inaccuracy in DeWiest's derivation and found an expression for the coefficient equal to the one originally given by Jacobs (1950). Madsen has derived a governing equation equivalent to Cooper's equation 20, supporting Jacob's form of storage coefficient. — ESL

06471 **Maher, Patrick D.** Eagle gas accumulations of the Bearpaw uplift area, Montana, *in* Eastern Montana symposium — Montana Geol. Soc., 20th Ann. Conf. 1969: Billings, Mont., Montana Geol. Soc., p. 121-127, illus., 1969.

The Eagle formation is composed of a series of thick, porous, littoral sandstones which were deposited during a Cretaceous marine transgression; there are three units: upper, middle, and lower sandstones. The upper is 75 feet thick and is the primary gas source in the area. The middle sand produces less, and the lower sand even less; all are separated by shale. The Eagle is arched by the Bearpaw uplift, and a gas field is thought to have been present in this arch before later erosion removed it. The Eagle in part was carried downward and outward by Cretaceous landslides and the

landslides carried with them the downdip edges of the paleogas field. This gas was then rerentrapped in normal fault blocks which occurred at the head of the slides. Numerous traps occur also in the thrusts at the toes of the landslides, but to date, only small amounts of gas have been found. — HRC

Major, W. M. *See* Romig, P. R. 06982

00046 **Majumdar, Dalim K.** Property interrelationships in sensitive clays — Discussion [of paper 6666 by W. N. Houston and J. K. Mitchell, 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM 1, p. 368, 1970.

Majumdar believes that some of the soil properties discussed in paper 6666 (ibid., v. 95, SM 4, p. 1037-1062, 1969) need to be defined more precisely, and gives Terzaghi's definition of the liquidity index, and the generally used definition of activity of clay. Houston's and Mitchell's comments on the possible relationship of cation exchange capacity and specific surface to sensitivity of clay would be appreciated. — ESL

Malone, Philip G. *See* MacTavish, John N. 07030

00059 **Manheim, Frank T.; Meade, Robert H.; Bond, Gerard C.** Suspended matter in surface waters of the Atlantic continental margin from Cape Cod to the Florida Keys: Science, v. 167, no. 3917, p. 371-376, illus., tables, 1970.

Appreciable amounts of suspended matter (>1.0 mg per liter) in surface waters are restricted to within a few kilometers of the Atlantic coast. Particles that escape estuaries or are discharged by rivers into the shelf region tend to travel longshoreward rather than seaward. Suspended matter farther offshore, chiefly amorphous organic particles, totals 0.1 mg per liter or less. Soot, fly ash, processed cellulose, and other pollutants are widespread. It is concluded that transport of suspended detritus via surface waters across the continental shelf to the regions of the continental slope is minimum during normal or near-normal conditions. Abnormal events such as storms and floods have a strong but quantitatively unknown effect on the transport of detritus in coastal waters. The continent is presently contributing little detritus to the continental slope and deeper regions of the Atlantic. — DBV

00037 **Mann, C. John.** Randomness in nature: Geol. Soc. America Bull., v. 81, no. 1, p. 95-103, 1970.

Recent recognition of randomness and apparent randomness in fluvial processes, geomorphic evolution, hydrology, landmass distribution, geographical shapes, seismic phenomena, stratification, and lithology, together with known randomness in such basic processes as radioactive decay, organic evolution, and galactic evolution suggest strongly that randomness is inherent in the natural process. Recognition that randomness is more common than formerly was admitted possible, and recognition that randomness may be a profound concept of nature, demand that geologists examine closely the extent and character of randomness in natural phenomena in an effort to ascertain if the randomness is inherent or simply apparent. — *from* Author's abstract

Marano, David. *See* Wilson, Stanley D. 00055

Marlette, John W. *See* James, Laurence B. 06884

06917 **Marsell, R. E.** Landscapes of the north slopes of the Uinta Mountains, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 1-15, illus., 1969.

This is a semipopular account of the topography of the north slope of the Uinta range. In general, the drainage is subparallel, the major streams descending the flanks of the mountain in a consequent arrangement, paralleling the dip of the beds on this giant anticline. The main topography is a product of Pleistocene glaciation, there

being examples of youthful, mature, and old stages of glacial relief available for inspection. Numerous moraines affect the drainage considerably. — HRC

06449 **Mason, Brian.** Pumpellyite of deuteric origin — A comment [on paper by A. Raam, S. Y. O'Reilly, and R. H. Vernon, 1969]: Am. Mineralogist, v. 54, nos. 7-8, p. 1215, 1969.

Raam et al did not know, when they wrote of the occurrence at Sydney, New South Wales, of any previously published account of pumpellyite occurring in a high-level intrusive or volcanic rock, not subjected to deep burial or geothermal activity. Mason points out that in 1960 he described pumpellyite lining vesicles in Triassic basalt at Summit, New Jersey, where it is clearly deuteric. — ESL

06914 **Mason, Brian.** Composition of stony meteorites, *in* Extra-terrestrial matter (C. A. Randall, Jr., editor): DeKalb, Ill., Northern Illinois Univ. Press, p. 3-22, illus., tables; discussion, p. 22-24, 1969.

Studies of meteorites suggest they are samples of material which crystallized at an early stage of the solar system's development. Mineralogy and structure of chondrites indicate a variety of formation conditions. Structure of enstatite chondrites indicates crystallization at temperatures as high as 1500°C; hydrates in carbonaceous chondrites show formation under cold and humid conditions. These meteorites represent samples from different regions of an ancestral solar nebula where temperature ranged from very hot near center to cold on margins. Chondrites are an inhomogeneous aggregation of solid materials which may have never completely melted; achondrites and stony-irons appear to have originated in asteroids which grew large enough to melt or partially melt. Differentiation could have occurred by gravitational separation and fractional crystallization. — *from* Author's abstract

Masters, J. A. *See* McKenny, J. W. 00009

Masursky, Harold. *See* McCauley, John F. 06919

McAdoo, Gene. *See* Gabrysch, R. K. 06931

McCain, J. F. *See* LaMoreaux, P. E. 06649

00013 **McCarthy, James A.** The Miocene trend of Calhoun and Matagorda Counties, Texas: Houston Geol. Soc. Bull., v. 12, no. 5, p. 4-14, 20-24, illus., 1970.

The Miocene trend offers multiple-pay gas and oil sands above 6,500 feet; more than a dozen fields are already producing from this trend, with over 90 percent of all production from the middle Miocene. Production is shown on a histogram, and structure contour maps and sections are given for three examples of producing fields. Regional structural geology is discussed and three major structural trends — Miocene fault complex, Steamboat Pass-Collegeport Ridge, and Miocene uplift — are illustrated by Bouguer gravity maps and diagrammatic sections. Comparisons of isopach maps with structure maps on the basal Miocene show an obscuring of the Miocene uplift by later south tilt; the up-to-the-coast fault trend is not a primary trend, but secondary, occurring late in the Miocene. There is now 400 feet of dip between Collegeport field and the Miocene uplift. — ESL

06919 **McCauley, John F.; Masursky, Harold.** The bedded white sands at Meteor Crater, Arizona [abs.]: Meteoritics, v. 4, no. 3, p. 196-197, 1969.

06528 **McCormick, C. D.; Picard, M. Dane.** Petrology of Gartra Formation (Triassic) Uinta Mountain area, Utah and Colorado: Jour. Sed. Petrology, v. 39, no. 4, p. 1484-1508, illus., tables, 1969.

Based on lithology, sedimentary structures, and weathering characteristics, the Gartra is informally divided into three subunits. The lower is conglomeratic, poorly sorted, massive, and poorly bedded sandstone; the middle is finer grained sandstone and contains dominant planar and trough cross-laminations. The upper unit is finer

grained and is claystone and siltstone and fine to medium-grained sandstone; horizontal and small scale cross-stratification are characteristic. The sandstone of all units is dominantly subarkose. Paleocurrent directions are west and northwest, and detritus was derived from plutonic, sedimentary, and gneiss-schist terranes on the east and southeast. The Gartra probably was deposited by a series of west-northwest flowing streams on a broad alluvial plain. Gradual decreasing velocity and turbulence of stream currents were responsible for the fining-upward sequence. — *from* Authors' abstract

06987 **McCulloch, D. S.; Bonilla, M. G.; Borgman, G. N.; Vardy, Peter; Wilhelm, Robert O.; Wallace, Robert E.; Mader, George G.; Johnson, Arvid M.; Borcherdt, R. D.; Atkinson, Sterling K., Jr.** San Francisco Peninsula trip for planners and public officials, Field Trip 5 *in* 1969 field trips — Assoc. Eng. Geologists, Natl. Mtg., San Francisco, Calif., 1969: [Berkeley, Calif.] Assoc. Eng. Geologists, p. E1-E10, illus., 1969.

Field trip 5 visited sites of interest in connection with problems of the geologic suitability of building sites in the rapidly expanding urban centers of the San Francisco Bay area. Litigation arising from unwise land use has placed increased liability for damage on the developer, thus making it clear that careful site studies must be made before construction is started. The geologic hazards to urbanization (including earthquakes) can be minimized if the problems are recognized and evaluated in community planning; the financial penalties for disregarding these problems can be immense. — DBV

00067 **McGetchin, T. R.; Silver, L. T.; Chodos, A. A.** Titanoclinohumite — A possible mineralogical site for water in the upper mantle: Jour. Geophys. Research, v. 75, no. 2, p. 255-259, table, 1970.

Titanium-rich clinohumite and layered structure minerals are observed in kimberlite and as inclusions in pyropic garnets from the Moses Rock dike, a kimberlite-bearing breccia dike in San Juan County, Utah. Associated clinopyroxenes observed as inclusions within similar pyropes and also in kimberlite are estimated to have equilibrated at depths ranging from about 50 to 150 km at modest temperatures, generally less than 1,000°C. The presence of titanoclinohumite, a high-density hydrous phase, is of considerable interest as a possible site for volatiles in the Earth's upper mantle. Dehydration of hydrous phases such as titanoclinohumite within the upper mantle may provide water as a free phase, could be important in the genesis of kimberlite and alkali-basalt magma, and may be one means of producing a low-velocity zone in the upper mantle. — Authors' abstract

00074 **McGinnis, L. D.** Tectonics and the gravity field in the continental interior: Jour. Geophys. Research, v. 75, no. 2, p. 317-331, illus., 1970.

Detailed gravity surveys over large areas in Illinois are used to determine mechanisms of crustal movements, and interpretations are extended to other areas having similar geologic-gravity relationships. A mosaic pattern of gravity highs and lows outlines mass concentrations that formed during the evolution of the craton. Intercratonic basins are interpreted as representing the terminal stage of more subdued rifting. Numerous ancient rift systems in the craton suggest that mantle convection played an important part in the deformation of the youthful continental crust. Erosion and sedimentation resulted in further deflections, of an isostatic nature, with subsequent faulting and plutonism. — *from* Author's abstract

McIntyre, Andrew. *See* Bé, Allan W. H. 06432

00009 **McKenny, J. W.; Masters, J. A.** Limestone likely source of oil in igneous sill: World Oil, v. 170, no. 1, p. 57-60, illus., 1970.

Dineh bi Keyah field located near the northwesteren end of the Toadlena anticline in northeastern Arizona is probably the world's largest current producer of crude oil from an igneous reservoir. The discovery well was the Kerr-Magee Corp. Navajo 1, Apache County, Arizona. The field produces from 17 wells spaced on a 160-acre pattern. Cumulative production is about 7.5 million bbl. The sill (reservoir), which is of

Tertiary age, intruded Lower Pennsylvanian rocks and is a dark gray to greenish-gray syenite rock while the host rock is dark gray, finely crystalline to dense limestone with interbedded gray, calcareous shale. — GHD

06908 **McKenzie, Garry D.** Observations on a collapsing kame terrace in Glacier Bay National Monument, south-eastern Alaska [with French and German abs.]: Jour. Glaciology, v. 8, no. 54, p. 413-425, illus., table, 1969.

Detailed observations on a collapsing kame terrace indicate that the terrace is being reshaped by: slumping and sliding of debris into depressions, melt-water erosion on the side of the terrace, debris flows in the gullies, and stagnant-ice bursts; a phenomenon analogous to a glacier burst except in the mode of formation of the water. Temperatures in the gravel over the ice, where the gravel is about 4 m thick, indicate that the rate of melting of the upper surface of the ice due to conduction may be as high as 24 cm per yr^{-1}. Highest temperatures in the gravel were recorded during periods of heavy rainfall. — Author's abstract

06885 **McKeown, F. A.; Dickey, D. D.** Fault displacements and motion related to nuclear explosions: Seismol. Soc. America Bull., v. 59, no. 6, p. 2253-2269, illus., 1969.

Movement has been triggered on some faults near underground nuclear explosions in Nevada and Amchitka Island, Alaska. Permanent relative vertical displacement, always in the same direction as the last recognizable natural tectonic displacement, was as much as 1 m; horizontal displacement of as much as 15 cm occurred on a few faults where no previous horizontal displacement was apparent. Strike length of triggered faulting (1 to 8 km) seems to correlate linearly with yield and magnitude of explosions. High-speed motion picture photography of two faults from the air and ground shows that the fault motion started at the first arrival of seismic energy; rupture velocity on triggered faults was 2.1 kmps in alluvium in Hot Creek Valley, Nevada; and velocity of displacement of alluvium on Yucca Flat fault plane was a little more than 1 mps, and on Hot Creek Valley fault plane, between 6 and 30 mps. — DBV

McKern, Sharon. *See* McKern, Thomas W. 06580

06580 **McKern, Thomas W.; McKern, Sharon.** Human origins — An introduction to physical anthropology: Englewood Cliffs, N. J., Prentice-Hall, 204 p., illus., tables, 1969.

This brief introduction to physical anthropology condenses the larger issues of the subject while striving to impart the fundamental facts and problems involved at an introductory level. Chapter headings are: introduction, man in nature, evolution in theory, evolution in fact, geologic time, fossil primates, fossil man, cultural prehistory, primatology, heredity, human variation, race, and anthropology today and tomorrow. Suggested readings follow each chapter;a subject index is appended. — MCM

06511 **McLaughlin, W. A.; Berkshire, D. C.** Nitrobenzene-tetrabromoethane solutions for the gravity separation of minerals: Jour. Sed. Petrology, v. 39, no. 4, p. 1610-1615, illus., tables, 1969.

The laboratory separation of microfossils or mineral fractions using heavy liquids is greatly facilitated providing the density of the medium can be routinely controlled to a few tenths of 1 percent. It is shown that nitrobenzene-tetrabromoethane solutions of the commercially available compounds can be routinely prepared to any required density between 1.20 grams per cc and 2.95 grams per cc with an accuracy better than 0.1 percent. Concentration-density relationships are given for solutions at 20°C, 25°C, and 30°C. — Authors' abstract

06658 **McLeod, C. R.; Chamberlain, J. A.** Reflectivity and Vickers microhardness of ore minerals — Chart and tables: Canada Geol. Survey Paper 68-64, 2 sheets, 1969.

The chart, designed as a laboratory aid in determining opaque minerals in polished sections, carries brief explanatory notes. Microhardness and reflectivity mean and

range values used are "best values" as selected by the writers. Where possible, reflectivity values are those obtained in white light with a variety of instruments. Minerals showing strong bireflections have large "ranges" of R, which may represent two sets of values rather than true ranges. The first of the three tables lists approximately 220 minerals, includes references, and is arranged in alphabetical order. The second is arranged according to microhardness, and the third by reflectivity. — ESL

06490 **McMahon, Barry K.** Quantification of geology as a tool in the planning of block cave mines [abs.], *in* Engineering geology and soils engineering symposium, 7th Ann., Moscow, Idaho, 1969, Proc.: Boise, Idaho, Idaho Dept. Highways, p. 159, 1969.

McManus, Dean A. *See* Carson, Bobb. 06751

McMillion, Leslie G. *See* Scalf, Marion R. 06414

McNiven, H. D. *See* Ewoldsen, H. M. 06948

06949 **McNiven, H. D.; Ewoldsen, H. M.** Rockbolting of tunnels for structural support — Pt. 1, Theoretical analysis: Internat. Jour. Rock Mechanics and Mining Sci., v. 6, no. 5, p. 465-481, illus., 1969.

Preliminary rational design procedures are developed for choosing the geometric array of bolts for several idealized cases of rockbolting of tunnel walls. This first part covers a review of stress analysis around a tunnel in a gravitating medium and the stress field created by a single rockbolt. Computations are carried out to obtain typical stress fields and to demonstrate the influence of certain factors, mainly the influence of the historic state of stress on the stress field surrounding a tunnel in a gravitating medium. — *from* Authors' abstract

Meade, Robert H. *See* Manheim, Frank T. 00059

06903 **Mellor, Malcolm.** The stress dependence of the secondary creep rate at low stresses — Reply to Professor J. Weertman's letter [1969, discussing two papers by M. Mellor and R. Testa, 1969]: Jour. Glaciology, v. 8, no. 54, p. 495, 1969.

The paper by Mellor and Testa (ibid., no. 52, p. 147-152, 1969) was prompted by disbelief in the claimed Newtonian behavior of ice at deviator stresses below 1 bar, and results seem to discredit the evidence on which it is based. The final conclusion that classical creep tests become impractical for stresses below 0.5 bar seems to be in complete accord with Weertman. It was carefully pointed out in the paper that results do not establish a firm stress/strain-rate relation for the low stress range. The inadequacy of existing data for the low stress range is conceded but the implication that a simple power relation (for ice) must be maintained over an indefinite range of strain-rates is questioned. Evidence of new studies is mentioned. — VSN

06384 **Melton, William G., Jr.** A new dorypterid fish from central Montana: Northwest Sci., v. 43, no. 4, p. 196-206, illus., 1969.

A new fish fauna from the Early Pennsylvanian(,) Bear Gulch Limestone in southeastern Fergus County, Mont., contains at least five paleonisciforms and one coelacanth. *Allenypterus montanus*, n.gen., n.sp., a deep-bodied paleonisciform preserved in lithographic detail in the fine-grained limestone, is placed in the Dorypteridae, the most specialized family of the suborder Platysomoidei, and hitherto represented only by *Dorypterus* from the Permian of Europe. *Allenypterus* is on the whole more primitive than *Dorypterus* but, because of certain specializations, it is not considered a direct ancestor. — VMJ

07032 **Meyerhoff, A. A.; Khudoley, K. M.; Hatten, C. W.** Geologic significance of radiometric dates from Cuba: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 12, p. 2494-2500, illus., tables, 1969.

Nine radiometric dates from Cuba indicate that at least two thermal events have affected the island. One is 103-121 m.y. old (Neocomian-Cenomanian), and may correspond to an Early to middle Cretaceous orogeny. Probably most of the granodioritic plutons of central and western Cuba are Early to Middle Cretaceous. A 180-m.y. date (Early Jurassic) from southern Las Villas Province does not fit the known history of Cuba. Dates ranging from 61 to 78 m.y. (Campanian-early Paleocene) in the central and western parts of Cuba may reflect the onset of Campanian-Eocene orogeny, which culminated with the intrusion, 46-58 m.y. ago (late Paleocene-middle Eocene), of quartz diorite batholiths and stocks in southern Oriente Province, eastern Cuba. — *from* Authors' abstract

Meyerhoff, A. A. *See* Bryant, William R. 07033

Meyn, H. D. *See* Card, K. D. 07010

Mieghem, J. van. *See* Landsberg, H. E. 06909

Miesch, A. T. *See* Shacklette, Hansford T. 00002

06404 **Miller, Charles N., Jr.** *Pinus avonensis*, a new species of petrified cones from the Oligocene of western Montana: Am. Jour. Botany, v. 56, no. 9, p. 972-978, illus., 1969.

The first structurally preserved ovulate cones of *Pinus* reported from the Tertiary of North America are about 5.5 cm long and have a maximum diameter of 2.5 cm. Numerous scales are arranged spirally around the axis, each bearing two winged seeds. The bract subtending the ovuliferous scale is 3-4 mm long and is free from the scale. The pith and cortex of the axis are constructed of thick-walled parenchyma cells, and 18-21 resin canals occur at the inner edge of the cortex. Resin canals entering the base of the ovuliferous scale are restricted to the abaxial side with vascular tissues occupying the adaxial side. Vascular strands near the tip of the scale are strongly rounded on the adaxial or phloem side. At the abaxial side of the tip of the ovuliferous scale is a broadly rounded rhomboidal apophysis with a raised umbo that terminates in a short spine. It has affinity with the subgenus *Diploxylon*. — *from* Author's abstract

Miller, Donald S. *See* Haglund, David S. 06538

Miller, S. L. *See* Castillo, F. 06753

06391 **Milliman, John D.** Four southwestern Caribbean atolls — Courtown Cays, Albuquerque Cays, Roncador Bank and Serrana Bank: Atoll Research Bull. 129, 26 p., illus., tables, 1969.

The environment and ecologic zonations of the atolls are described; the same general zonations are present at each. Although coral and algae are abundant, other fauna and flora are sparse. Ecologic zonations are similar to other Caribbean reefs, but have a luxuriance reminiscent of Indo-Pacific reefs. The emergent *Millepora* zone on the outer edge of the windward reef flat appears to be the equivalent of the Indo-Pacific algal ridge. The lack of massive red algal encrustation is the main feature differentiating these atolls from those of the Indo-Pacific. — *from* Author's abstract

07031 **Milton, Charles; Grasty, Robert.** "Basement" rocks of Florida and Georgia: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 12, p. 2483-2493, illus., tables, 1969.

Petrographic, chemical (11 rock analyses), and age determinations (7 whole-rock K-Ar) were made on 27 well samples from Florida, and 3 K-Ar determinations on samples from Georgia. Specimens include diabase, basalt, rhyolite, and generally unaltered basaltic and rhyolitic ash. Ages for igneous rocks are as young as 89.3 ± 2.2 m.y., and for metamorphosed "granite" and "diorite", possibly altered arkosic rocks, 480 to 570(?) m.y.; a Paleozoic (Middle Carboniferous) age also was found for hornblendite from western Georgia. No unambiguous Piedmont-type metamorphic rocks have been found by drilling in Florida. [Whether the "basement" rocks belong to a

truly metamorphic Precambrian or Paleozoic basement is an open question.] — *from* Authors' abstract

06978 **Mitchell, Richard S.** Phosphosiderite associated with nelsonite rock in Nelson County, Virginia: Southeastern Geology, v. 11, no. 1, p. 37-42, tables, 1969.

Greenish cryptocrystalline phosphosiderite occurs in hydrothermally altered ilmenite-nelsonite dike rocks in Nelson County, Va. Strengite, dimorphous with phosphosiderite, also occurs but it is much rarer. Indexed X-ray powder data are given for both minerals. In addition to ilmenite and apatite which are essential to the nelsonite, associated minerals are talc, chlorite, anatase, and wavellite. — Author's abstract

Mitchell, Steven W. *See* Driscoll, Egbert G. 06959

Mobley, A. B. *See* Guinnee, John W. 06488

Mohsen, Lotfi. *See* Brownlow, Arthur H. 06853

06983 **Molnar, Peter; Klaus, Jacob; Sykes, Lynn R.** Microearthquake activity in eastern Nevada and Death Valley, California, before and after the nuclear explosion BENHAM: Seismol. Soc. America Bull., v. 59, no. 6, p. 2177-2184, illus., tables, 1969.

Six portable, high-grain, high-frequency seismographs were operated in Nevada and California for several weeks before and after the underground nuclear explosion BENHAM to assess the possibility that earthquakes at distances of tens of kilometers or more may be triggered by large underground explosions. A pronounced increase in earthquake activity in the vicinity of the shot point was observed immediately after detonation and continued for more than a month but no significant changes were observed elsewhere. This particular explosion apparently did not significantly affect the seismicity of the region studied. Throughout the period of observation the seismic activity northeast of the Nevada Test Site was low, suggesting that the current tectonic activity of this part of Nevada is lower than that of most other tectonically active regions where microearthquake studies have been made. — *from* Authors' abstract

Monges Caldera, J. *See* Woollard, G. P. 07022

06422 **Monroe, Frederick F.** Oolitic aragonite and quartz sand — Laboratory comparison under wave action: U.S. Army Corps Engineers Coastal Eng. Research Center Misc. Paper 1-69 [82] p., illus., tables, 1969.

Oolitic aragonite (or oolite) occurs in the Bahama Islands and has been suggested as a material for beach nourishment. CERC tested oolite under laboratory wave conditions by comparing it with quartz sand with the same hydraulic size characteristics. Early tests indicated that both materials behaved similarly under various wave heights and periods. Another test simulated beach nourishment; the two materials behaved almost identically. Since materials used had prototype characteristics and were compared in a small-scale laboratory test, no accurate correlation to a prototype wave climate can be projected. The softness of oolite and the possibility of biological contamination could be significant in large field tests. — Editor's abstract

06443 **Moore, Alan C.** A method for determining mineral compositions by measurement of the mass absorption coefficient: Am. Mineralogist, v. 54, nos. 7-8, p. 1180-1189, illus., table, 1969.

Direct measurements of μSrK_{alpha} on chemically analyzed plagioclases demonstrates the applicability of the method. Straight line regression for 41 plagioclase samples gives the following equation: An percent = 25.27 μSrK_{alpha} — 164.66, with a standard deviation of 1.61 percent An. The method can be extended to other solid solution series, such as olivine, orthopyroxene, and zincblende series; calculated values of μSrK_{alpha} for different members of these series are presented. By selection of wavelengths of absorbed X-ray beam, effects of interfering elements can be reduced

to a minimum. Although experimental work reported here was done using an X-ray spectrograph, measurements of μ can be made using a diffractometer. The advantage of this method over other indirect methods is that measured values of μ are directly related to the chemical compositions. — *from* Author's abstract

Moore, Bruce R. *See* Dennen, William H. 06779

07042 **Moore, Carleton B.** Cosmic debris: Boston, Mass., and Toronto, Ontario, Little, Brown and Co., 108 p., illus., 1969.

Various types of meteorites are described here, with their clues to cosmic history, and the Earth's age and origin. In 4.6 billion years, 5 trillion tons of cosmic material has fallen on Earth, up to 10,000 tons a day; most is microscopic dust, plowed in or washed away, preserved in sea-bottom sediments and polar glaciers. Each year about 200 recoverable meteorites strike, but seldom in accessible or populated areas; for scientific value finds should be promptly reported. The trajectory of one in Czechoslovakia was tracked by two cameras. The Prairie Network of cameras 200 to 300 miles apart has been installed recently in the United States; each photocell is triggered by light of a fireball. — GDC

Moore, D. B. *See* LaMoreaux, P. E. 06649

Moore, E. James. *See* Desai, K. P. 06867

06546 **Moore, George T.** Interaction of rivers and oceans — Pleistocene petroleum potential: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 12, p. 2421-2430, illus., tables, 1969.

Rivers (± deltas), submarine canyons, and abyssal fans are considered as one dynamic system. River loads may be deposited near the river mouth or, because of several factors, conveyed through submarine canyons to the abyssal plain and deposited as submarine cones or redistributed to form a continental rise. Although deep-water Cenozoic sediments are known to contain large petroleum reserves in some basins, only modest amounts of oil and gas are presently known in Pleistocene sediments. During the Pleistocene, a river regimen different from most earlier Cenozoic ones may have resulted in transportation of great volumes of sediment to the base of the continental slope. The resulting submarine fans may contain petroleum reservoirs comparable to those in deltas. — EGS

06503 **Moore, Harlan E.** Foundation design of the Camas Prairie Railroad, *in* Engineering geology and soils engineering symposium, 7th Ann., Moscow, Idaho, 1969, Proc.: Boise, Idaho, Idaho Dept. Highways, p. 33-47, illus., 1969.

Results are presented of laboratory and field tests on soils, conducted in connection with relocation of the Camas Prairie Railroad. The effect of capillary tension was found to be very important. It was found also that pore pressures do not develop upon consolidation as these soils are saturated. These results explain the engineering properties of a rather limited group of angular nonplastic silty soils; care should be taken in attempting to apply them to other soils. — DBV

06643 **Moore, Homer C.** Engineering interpretations of soil data, *in* Engineering geology and soils engineering symposium, 7th Ann., Moscow, Idaho, 1969, Proc.: Boise, Idaho, Idaho Dept. Highways, p. 234-246, illus., 1969.

This paper points out some engineering interpretations that can be made of the national cooperative soil surveys. These surveys are intended to serve as a program planning tool for engineers and geologists. In Idaho, the information is on file in some 50 Soil Conservation Service offices in the state or is contained in published reports. Soil classification systems are reviewed briefly. Engineering interpretations of mapping symbols are described; maps can be made showing general areas with specific interpretations, such as, for instance, soil limit for septic tanks. — DBV

06676 **Moore, P. B.; Bennett, J. M.; Louisnathan, S. J.** Ashcroftine is not a zeolite!: Mineralog. Mag., v. 37, no. 288, p. 515-517, tables, 1969.

The original material, from Narsarsuk, Greenland, was declared a new mineral by Gordon (1924) and a zeolite by Hey and Bannister (1933). More sophisticated analyses show its tentative formula to be $KNaCa[Yt(OH)_3]_2[Si_6O_{15}(OH)_6]\cdot 4H_2O$, Z = 16, and hence not a zeolite. — HRC

06453 **Moore, Paul B.** A novel octahedral framework structure — Gageite: Am. Mineralogist, v. 54, nos. 7-8, p. 1005-1017, illus., tables, 1969.

Gageite, ideally $M^{2+}_7(O)(OH)_8[Si_2O_6]$ where M = Mn and Mg, a 13.79(2), b 13.68(2), c 3.279(3) A, *Pnnm*, Z = 2, is an octahedral pipe structure. This unusual structure consists of walls of edge-sharing octahedra corner-linked to bundles of edge-sharing octahedra leaving pipe-like channels which run parallel to the c-axis. The octahedral framework has the ideal composition $M^{2+}_7(O)(OH)_{12}$, with the oxide anion octahedrally coordinated by six manganese atoms. The channels are clogged by disordered silicate tetrahedra which support the framework by a network of hydrogen bonds. The tetrahedra are not geometrically compatible with the arrangement of octahedra, resulting in anomalous behavior of the atoms within the pipes. — Author's abstract

00018 **Moores, E. M.; Scott, R. B.; Lumsden, W. W.** Tertiary tectonics of the White Pine-Grant Range region, east-central Nevada, and some regional implications — Reply [to discussion by H. Drewes, 1969, of 1968 paper]: Geol. Soc. America Bull., v. 81, no. 1, p. 323-329, illus., 1970.

In reply to Drewes discussion (ibid., p. 319-321), Moores, et al, point out that they did not mean to imply that all deformation was the result of a single orogenic epoch in late Tertiary. It is clear from study of the Horse Camp sediments that deformation was continuous during much of the time of deposition. They do not feel however that their conclusion that most low-angle faults in the region are of Tertiary age has been disproven. The structural controversy surrounding interpretation of the hinterland of the Sevier Orogenic Belt is reviewed and the dominant features of the White Pine-Grant Range area related to that controversy. Various drafting and publishing errors on the original map are indicated. — VSN

06452 **Morimoto, Nobuo; Tokonami, Masayasu.** Oriented exsolution of augite in pigeonite: Am. Mineralogist, v. 54, nos. 7-8, p. 1101-1117, illus., tables, 1969.

Pigeonite crystals from Moore County meteorite show oriented exsolutions of two augites parallel to (001) and (100). Two-dimensional agreement is indicated not only in orientation but also in cell dimensions along boundary planes. Assuming the two augites have identical compositions and difference in cell dimensions is due to lattice distortions in the exsolution, corrected cell dimensions were estimated by using elastic constants. Strain energies were estimated to be 0.02 and 0.04 kcal/mole for the exsolved augites based on changes of cell dimensions. Pigeonite crystals from Skaergaard intrusion, studied for comparison, show exsolved augite in only one orientation, not perfectly parallel to (001) of the pigeonite, and its intrinsic cell dimensions free from lattice distortions, suggesting that pigeonite from the meteorite represents an intermediate stage in exsolution of augite. — *from* Authors' abstract

06392 **Morrison, B.** A side-wall sampler [with French abs.]: Canadian Geotech. Jour., v. 6, no. 4, p. 432-439, illus., 1969.

A side-wall sampler which is capable of taking samples from the walls of testholes to a depth of 1000 feet or more is described. Samples have been extracted from till, clay, silt, and fine- to coarse-grained sands in drift and nonindurated bedrock from more than 1000 testholes in southern Saskatchewan. Side-hole sampling is faster and cheaper than conventional sampling methods and is ideally suited for geological investigations. Mineralogical, paleontological, and radiocarbon analyses have been determined on side-hole cores. — Author's abstract

Morton, J. D. *See* Trow, W. A. 06421

06437 **Mosher, L. Cameron.** Nomenclatural revisions for Triassic conodonts in Mosher, 1968: Jour. Paleontology, v. 43, no. 6, p. 1441, 1969.

The generic name *Didymodella* is proposed to replace *Dichodella* Mosher, preoccupied by *Dichodella* Serpagli, 1967. *Neospathodus lanceolatus* Mosher and *Oncodella idiodentica* Mosher are placed as junior subjective synonyms of *N. hernsteini* (Mostler) 1967 and *O. paucidentata0* (Mostler) 1967, respectively. — JWH

06534 **Mothersill, John S.** A grain size analysis of longshore-bars and troughs, Lake Superior, Ontario: Jour. Sed. Petrology, v. 39, no. 4, p. 1317-1324, illus., 1969.

Grain size analysis of 186 samples from the axes of longshore-bars and troughs along the lake shelf at Batchawana Bay and Pancake Bay, Lake Superior, Ontario, show the longshore-bar sands to be better sorted and finer grained than the adjacent shoreward longshore-trough sands. In addition, the longshore-bar sands are unimodal and tend to be positively skewed whereas the longshore trough sands may be either unimodal or bimodal and show a tendency towards negative skewness. This would suggest that the longshore troughs were formed by the action of breaking waves that preferentially set the finer grained particles into motion. These finer grained particles were then moved lakeward by the undertow to form the longshore-bar areas. — Author's abstract

Mudie, J. D. *See* Sclater, J. G. 00073

Mudie, John D. *See* Spiess, Fred N. 06577

Mudrey, M. G., Jr. *See* Goldich, S. S. 06706

06981 **Mueller, R. A.** Seismic energy efficiency of underground nuclear detonations: Seismol. Soc. America Bull., v. 59, no. 6, p. 2311-2323, illus., table, 1969.

The amount of energy going into the formation of elastic waves in the far field radiation zone was determined for the underground nuclear explosions BOXCAR, BENHAM, SALMON, SCHOONER, SHOAL, and STERLING. The method is based on Sharpe's spherically symmetric model. The analytical solution of Sharpe's problem is developed into an energy equation and applied to the experimental results. The results obtained in this manner are in the same range found by other investigators. A basic conclusion is that seismic energy efficiency appears to be significantly lower for cratering events than for contained events. — Author's abstract

Muirhead, K. J. *See* Cleary, J. R. 06953

06521 **Mukherji, Kalyan Kumar.** Supratidal carbonate rocks in the Black River (Middle Ordovician) Group of southwestern Ontario, Canada: Jour. Sed. Petrology, v. 39, no. 4, p. 1530-1545, illus., tables, 1969.

Petrographic and mineralogic characters can be used to define four major units in the Black River Group of southwestern Ontario. The presence of large scale sedimentary structures, extremely high dolomite content, abundance of anhydrite, celestite in insoluble residues, and certain textural features suggest a shallow water environment with high salinity and subaerial exposure of wide aerial extent during the deposition of the two lower units. These basal carbonates of the Black River Group are considered to be ancient analogs of the present day supratidal carbonate environments. — Author's abstract

06657 **Muller, J. E.; Carson, D. J. T.** Geology and mineral deposits of Alberni map-area, British Columbia (92F): Canada Geol. Survey Paper 68-50, 52 p., illus., tables, geol. map, 1969.

The map-area occupies a central part of Vancouver Island and four islands in the Strait of Georgia. The Pennsylvanian-Permian Sicker Group consists of a basal section dominated by greenschist and greenstone, and overlain by sedimentary rocks. The overlying Karmutsen basalt is at the base of the Triassic-Jurassic Vancouver Group. Both Groups are invaded by Jurassic batholiths. The Upper Cretaceous Nanaima Group, near the east coast, is divided into four transgressive cycles; this group and older rocks are intruded by sills and stocks. Oldest structures are north-northwesterly trending uplifts, of pre-Late-Cretaceous age, partly fault-bounded.

Folding is restricted to fault zones and occurred during mid-Mesozoic orogeny; block faulting and tilting are Tertiary. Mineral deposits are massive zinc-copper-lead sulfides, copper- and iron-bearing skarns, and gold-quartz veins. — *from* Authors' abstract

06890 **Murphy, J. R.; Lahoud, J. A.** Analysis of seismic peak amplitudes from underground nuclear explosions: Seismol. Soc. America Bull., v. 59, no. 6, p. 2325-2341, illus., tables, 1969.

Ground-motion data from 99 underground nuclear events of 1 to 1,200 kt yield are analyzed. Data were measured at more than 500 stations at distances from less than 1 to about 600 km. A comparison of results of the statistical analysis with expected results, using cube-root of yield scaling concepts, shows that the peak amplitude of displacement cube-root scales, whereas peak acceleration and velocity do not cube-root scale. Relative differences in yield and distance exponents, n and m, obtained from the statistical analysis are explained in terms of differences in frequency content of recorded ground motions. Observed peak amplitude measurements from events BOXCAR and BENHAM are compared with predictions. — DBV

06560 **Murphy, John R.** Discussion of paper by D. Springer, M. Denny, J. Healy, and W. Mickey, "The Sterling experiment — Decoupling of seismic waves by a shot-generated cavity" (1968): Jour. Geophys. Research, v. 74, no. 27, p. 6714-6718, illus., 1969.

Additional theoretical analyses verified with data obtained over a wider frequency band than that investigated in the paper under discussion (ibid., v. 73, no. 18, p. 5995-6011, 1968; Abstracts of N. Am. Geology, March 1969) indicate that the decoupling at low frequencies is somewhat less than suggested by the data in the vicinity of 1 Hz. The observed frequency dependence is explained in terms of a simple analytical expression. — DBV

00043 **Murphy, Michael A.; Gronberg, Eric C.** Stratigraphy and correlation of the lower Nevada Group (Devonian) north and west of Eureka, Nevada: Geol. Soc. America Bull., v. 81, no. 1, p. 127-135, illus., 1970.

The McColley Canyon Formation, Lower Devonian of central Nevada, is divisible into three members, the Kobeh, Bartine, and Coils Creek in ascending order. The two lower members have been mapped in the Sulphur Springs Range, Roberts Mountains, Lone Mountain, and Table Mountain. The Coils Creek Member has been mapped in the latter three ranges, but its stratigraphic position is occupied by the lower Union Mountain Formation in the Sulphur Springs Range. This correlation indicates a late Early Devonian age for the lower part of the Union Mountain Formation. The Coils Creek Member bears the *Elythyna* fauna in its upper part, which, though small, is distinct from the *Eurekaspirifer pinyonensis* Zone fauna below and the *Leptathyris circula* above. — Authors' abstract

Mutchler, Calvin K. *See* Young, Robert A. 06405

06413 **Nace, Raymond L.** Arrogance toward the landscape — A problem in water planning: Bull. Atomic Scientists, v. 25, no. 10, p. 11-14, illus., 1969.

There is a growing political recognition that local and regional water problems are part of a national problem which cannot be approached effectively without new directions in planning and changes in public attitude. Examples of long-range consequences of water-resources development include ancient concepts in present "under-developed" countries of the world, once seats of the oldest civilizations, as well as dust bowl problems and other more modern management practices in the United States. Water and its movement through the hydrological cycle are essential means for maintaining the heat balance on Earth. Water is the prime agent that shapes or misshapes the landscape, now scarred by man. Man should contrive to aid nature; history is full of disasters caused by his mistakes. — GDC

Naftel, W. L. *See* Gabrysch, R. K. 06931

Neal, James T. *See* Rooney, Thomas P. 07028

06563 **Nelsen, Donald E.** Radar sounding of glaciers in the Icefield Ranges, *in* Icefield Ranges Research Project scientific results, V. 1 (V. C. Bushnell and R. H. Ragle, editors): New York, Am. Geog. Soc., and Montreal, Quebec, Arctic Inst. North America, p. 107, 1969.

Measurements were made from the air along the length of Kaskawulsh Glacier, the divide region between Kaskawulsh and Hubbard Glaciers, and along the upper Donjek Glacier to an altitude of 3800 m in 1967 with a radio echo sounder to determine the potential usefulness of the apparatus for mapping and studying glaciers. The technique proved successful in the divide region and would probably be useful in trenches as wide as the upper reaches of the Donjek Glacier. Because of a highly complicated return signal, no interpretation of the bottom echo could be made in highly fractured regions such as lower reaches of the Kaskawulsh. In the upper reaches of the Donjek, definite echoes were detected. More measurements would have to be made to determine whether these were from valley walls or from the glacier bottom. — MCM

Nelson, C. Hans. *See* Carlson, Paul R. 06537

Newland, Leo E. *See* Brown, Thomas E. 06424

Newnham, R. E. *See* Yoon, Hyo Sub. 06444

Nielsen, D. R. *See* Srinilta, Sam-arng. 07034

Nigrini, Catherine. *See* Gartner, Stefan, Jr. 06818

06395 **Nolan, T. B.** Adolph Knopf (1882-1966): Geol. Soc. London Proc. 1969, no. 1655, p. 128-129, 1969.

Normark, William R. *See* Spiess, Fred N. 06577

06670 **Nriagu, Jerome O.; Bowser, Carl J.** The magnetic spherules in sediments of Lake Mendota, Wisconsin: Water Research, v. 3, no. 11, p. 833-842, illus., tables, 1969.

Magnetic microspherical particles which occur in the bottom muds of Lake Mendota have been analysed chemically and mineralogically. The data suggest that these spherules are flue products derived from industrial and domestic activities and are being supplied to the lake either through the action of washing the atmosphere or as the detrital load of the influent streams and urban runoff. These particles are apparently unaffected by diagenetic changes and since the chronological pattern of the lake sedimentation is well documented, the distribution of these microspherical particles has been used to evaluate the role of man in the trophic evolution of the lake. — Authors' abstract

06556 **Nur, Amos; Simmons, Gene.** Stress-induced velocity anisotropy in rock — An experimental study: Jour. Geophys. Research, v. 74, no. 27, p. 6667-6674, illus., tables, 1969.

Application of uniaxial stress to a sample of granite causes elastic wave velocity anisotropy. Compressional waves travel fastest in the direction of the applied stress. Two shear waves travel with generally different speeds in any direction, exhibiting acoustic double refraction which increases with increasing stress. — Authors' abstract

06955 **Nur, Amos; Simmons, Gene.** The effect of viscosity of a fluid phase on velocity in low porosity rocks: Earth and Planetary Sci. Letters, v. 7, no. 2, p. 99-108, illus., tables, 1969.

The effective shear modulus of a low porosity rock depends strongly on the viscosity of any fluid phase present in the microcracks. The bulk modulus is essentially independent. These results applied to the Earth show remarkable (or perhaps fortuitous)

agreement between the laboratory data and the facts known about the velocity zone in the upper mantle. — Authors' abstract

06963 **Nur, Amos; Simmons, Gene.** The effect of saturation on velocity in low porosity rocks: Earth and Planetary Sci. Letters, v. 7, no. 2, p. 183-193, illus., tables, 1969.

V_p and V_s are often significantly lower near atmospheric pressure than at pressures of a few kilobars for dry rocks with porosity in the form of cracks. When such cracks are filled with water, however, this lowering of velocity is significantly diminished for compressional waves. In contrast V_s is unaffected by the presence of fluid; low velocity persists at low pressure. The shape of the pores in typical crystalline rocks plays an important role: increase in V_p due to saturation of pores occurs when the pores are in the form of cracks but not when they are in the form of round holes. — *from* Authors' abstract

06570 **Nuttli, Otto W.; Bolt, Bruce A.** P wave residuals as a function of azimuth — [Pt.] 2, Undulations of the mantle low-velocity layers as an explanation: Jour. Geophys. Research, v. 74, no. 27, p. 6594-6602, illus., tables, 1969.

A model is derived to explain the observed dependence of the P-wave delay times measured in California on azimuth of wave approach. The data are explained by variations in the depth to both the top and bottom of the mantle low-velocity channel for P-waves, the model having a velocity of 7.9 kmps at the top of the mantle, 7.2 kmps in the channel, and 8.2 kmps below the channel. Calculations show that the channel is thickest between the coast and the Central Valley of California and thins eastward below the Sierra Nevada. It is suggested that the lower surface of the channel rises in a westward direction from the coast. The model is compatible with Bouguer gravity data and heat flow data from the area. — GV

06918 **Nuttli, Otto W.** Tables of angles of incidence of P waves at focus, calculated from P tables (Herrin, et al, 1968): Earthquake Notes, v. 40, no. 3, p. 21-25, tables, 1969.

This supplement to the 1968 P-tables of Eugene Herrin (Seismol. Soc. America Bull., v. 58, no. 4, p. 1193-1241, 1968) contains a table giving the angle of incidence of P-waves at the earthquake focus as a function of epicentral distance, for focal depths of 0, 15, 50, 100, 150, 200, 300, 400, 500, 600, and 700 km, at intervals of one degree of epicentral distance from 15 to 100°. — GDC

06420 **Ogilvie, N. A.; Vostokova, E. A.** Combined geographical and geophysical methods for fresh groundwater exploration in deserts, *in* Internat. Geol. Cong., 22d, New Delhi 1964, Proc. Sec. 12, Geohydrology: New Delhi, India, Internat. Geol. Cong. Organising Comm., p. 175-193, illus., 1964 [1969].

Methods of hydrological mapping of deserts and semi-deserts and search for fresh ground water based on geological and geographical (visual and aerophotographic) and geophysical studies are discussed. The geographical and geophysical data are interpreted in terms of the various interdependent factors observed; many-dimensional relationships are established. The advantages of continuous aeroelectrical methods of search for small fresh free ground-water bodies are shown. The problem is analysed of distinguishing the boundary in homogeneous strata by electrical methods where ground-water salinity changes gradually. It is noted that when depths to the water table vary sharply, the estimation of ground-water salinity using electrical probing data should take into account rock consolidation due to the weight of overlying deposits. — GV

Ogilvie, R. E. *See* Duerr, J. S. 06457

06916 **O'Keefe, John A.** Origin of tektites, *in* Extra-terrestrial matter (C. A. Randall, Jr., editor): DeKalb, Ill., Northern Illinois Univ. Press, p. 57-85, illus., tables; discussion, p. 85-90, 1969.

Tektites are small green to black siliceous glass bodies which resemble obsidian but differ in chemical composition from terrestrial glasses. Although tektites appear in

many different shapes, two facts are significant: their size is of the order of centimeters, and their surfaces are always pitted, grooved, or moulded. Prior to the Surveyor experiments, opinion on the subject of the origin of tektites was fairly evenly divided between the proponents of a lunar origin and the proponents of a terrestrial origin. The successful series of experiments conducted by Professor Turkevich on the Surveyors in September and November of 1967 and January of 1968 have had a great impact upon the problems of lunar geology and thus upon the possible origin of tektites. The current thinking about their origin is discussed. [O'Keefe favors a lunar source.] — Author's abstract

06997 **O'Keefe, John A.** The microtektite data — Implications for the hypothesis of the lunar origin of tektites: Jour. Geophys. Research, v. 74, no. 27, p. 6795-6804, illus., 1969.

The distribution of microtektites provides more definite boundaries for the Australasian strewn field. This field does not completely encompass the Earth, but it encompasses so much of the Earth that, if it is the result of terrestrial impact, the initial velocity must have been more than 6 kmps for much of the material and almost none could have reached 7 kmps. It is noted that microtektites probably cannot be ablation droplets from larger tektites, that the bottle-green microtektites cannot be explained by processes of volatilization, and that there is evidence that Muong Nong tektites are the result of the welding of microtektites. It is therefore suggested that the microtektites came directly from the Moon and may represent the unwelded component of a lunar ash flow, of which the Muong Nong tektites are the welded component. — GV

06419 **Oldale, Robert N.** Geologic map of the Harwich quadrangle, Barnstable County, Cape Cod, Massachusetts: U.S. Geol. Survey Geol. Quad Map GQ-786, scale 1:24,000, sections, separate text, 1969.

Deposits in the Harwich quadrangle on inner Cape Cod, mostly gravelly sand, have been mapped as the Sandwich moraine, Harwich outwash plain, glacial lake, and glacial lake bottom deposits. Borehole data show them to be at least 160 feet thick and overlying a 153 feet thick silt that in turn is overlain by compact till 116 feet thick resting on crystalline basement. Because there are no major till layers at the base of the mapped deposits or interbedded with the silt, it is believed they were laid down during a single glaciation. Involutions and congeliturbate in the upper part of the glacial, and late-glacial eolian deposits attest to periglacial conditions during retreat of ice from Cape Cod Bay. The postglacial rise in sea level partly submerged the glacial deposits; marine processes formed sea cliffs, beaches and marshes, and onshore winds deposited the dunes. — MCM

06642 **Olmsted, Terry L.** Geological aspects and engineering properties of glacial till in the Puget Lowland, Washington, *in* Engineering geology and soils engineering symposium, 7th Ann., Moscow, Idaho, 1969, Proc.: Boise, Idaho, Idaho Dept. Highways, p. 223-233, illus., 1969.

By virtue of its gradation and glacial history, the Vashon Till provides an important surface upon which an almost unlimited number of engineering projects can be founded. Because of its good load-deformation characteristics it can provide excellent support for structures. As fill, it can be satisfactorily compacted only during dry weather, which limits its use in the Puget Sound area. Provisions must be made to prevent frost heave, spalling, and mudslides where it is exposed to freezing and thawing. — DBV

06543 **Olson, Walter S.** Thomas Carroll Wilson (1906-1969): Am. Assoc. Petroleum Geologists Bull., v. 53, no. 12, p. 2562-2563, portrait, 1969.

Olsson, Richard K. *See* Fox, Steven K., Jr. 06433

O'Reilly, W. *See* Day, R. 00070

07044 **Orowan, Egon.** The origin of the oceanic ridges: Sci. American, v. 221, no. 5, p. 102-119, illus., 1969.

Current models of sea-floor spreading and continental drift implying mantle convection are dismissed and an alternate explanation is offered. Volatiles migrating toward fractures in the Earth's crust caused by large scale tensile stress may cause serpentinization of peridotite. The accompanying volume increase could cause an upwelling resulting in an ocean ridge. Continental drift is caused by material flowing outward from the upwelling under the force of gravity. Many important geologic observations are ignored and others, such as transform faults, are misrepresented. — DWR

00026 **Otvos, Ervin G., Jr.** Development and migration of barrier islands, northern Gulf of Mexico: Geol. Soc. America Bull., v. 81, no. 1, p. 241-246, illus., 1970.

Historical evidence and drilling results indicate that barrier islands form by upward aggradation of submerged shoal areas. Subsequent extensive barrier island migration may completely obscure conditions of formation of the original barrier island. Migration may take place perpendicular, at oblique angles, or parallel to the mainland shoreline, and appears to be fastest in the latter direction. There is no evidence for barrier island formation from engulfed beach and dune ridges during the early stages of transgression. Many strand plain and chenier ridges form the same way as barrier ridges. — *from* Author's abstract

07041 **Overbey, William K., Jr.; Rough, Robert L.** Surface studies predict orientation of induced formation fractures in Appalachian area: Am. Petroleum Inst. Drilling and Production Practice 1968, p. 101-106, illus., 1969.

Preliminary investigations have demonstrated feasibility of correlating observed surface fracture trends with oil-reservoir fractures induced by hydraulic fracturing. Magnetic bearings of major vertical joints in outcropping formations were compared with compass bearings from bottom-hole packer-impression surveys of hydraulically induced wellbore fractures. Orientation of vertical fracture trends was established by plotting nearly 2,000 joint strike measurements from Salamanca sandstone outcrops at 16 locations throughout the Bradford oil field, Pa., and Allegany oil field, N.Y. One dominant set of joints trending N. 50° E., to N. 76° E. correlated well with wellbore fracture orientations in 19 of 21 of packer-surveyed wells in the two fields. Formation outcrop survey bearings were augmented by similar data obtained from aerial photographs and topographic relief maps. — *from* Authors' abstract

06659 **Owen, E. B.** Stratigraphy and engineering description of the soils exposed on a section of the Welland Canal By-pass Project (Contract 743), Ontario, Canada: Canada Geol. Survey Paper 69-31, 22 p., illus., 1969.

The methods and procedures used to forecast excavation requirements in the Welland Canal By-pass Project (Contract 743) are outlined. Comparison is made between geological conditions inferred before excavation and the conditions actually encountered by the contractor. [A sheet showing inferred and observed geological profiles accompanies the report.] — Author's abstract

06474 **Owens, James P.; Sohl, Norman F.** Shelf and deltaic paleoenvironments in the Cretaceous-Tertiary formations of the New Jersey Coastal Plain, Field Trip 2 *in* Geology of selected areas in New Jersey and eastern Pennsylvania and guidebook . . .—Geol.Soc.America, Ann.Mtg., Atlantic City, 1969: New Brunswick, N.J., Rutgers Univ. Press, p. 235-278, illus., 1969.

The northern Atlantic Coastal Plain consists of sediments deposited in a wide variety of continental, transitional, and marine environments. Pleistocene erosion of the emerged coastal plain has exposed nearly a complete stratigraphic sequence of formations ranging from Late Cretaceous (Cenomanian) through Pliocene(?). The coastal plain or continental terrace can be separated into four natural rock sequences, in ascending order: largely fluviatile-deltaic deposits of early Late Cretaceous age, the Raritan Formation; chiefly interstratified deltaic and shelf deposits of Late Cretaceous and early Tertiary age; sediments of middle Miocene-Pliocene(?) age; and sediments of Quaternary age. Deposits of the first three sequences demonstrate the contrast between the deposits formed in deltaic and shelf environments, and are compared with modern analogs from the Gulf of Mexico. — *from* Authors' abstract

Pakiser, L. C. *See* Eaton, J. P. 06793

06401 **Pamenter, Bev.** Polarquest door to Arctic offshore: Oilweek, v. 20, no. 37, p. 36-38, 54, illus., 1969.

This third, and largest, of the exploration programs that started with Geoquest in 1968, will be a four-year operation to provide basic offshore studies covering 350,000 sq mi of the Arctic Archipelago. Polarquest '70 involves the following programs: geologic, bathymetric, environmental, aeromagnetic, gravity, seismic refraction and reflection, logistics, feasibility, stratigraphic, oceanographic, and magnetotelluric. — ESL

06695 **Papezik, V. S.** Late Precambrian ignimbrites on the Avalon Peninsula, Newfoundland: Canadian Jour. Earth Sci., v. 6, no. 6, p. 1405-1414, illus., table, 1969.

The ignimbrites are in the Harbour Main Group and consist of ash-flow tuffs intercalated with tuff-breccias of various origins and minor volcanigenic sediments. Shard outlines are preserved and fragments of obsidian and perlite can be recognized; albite crystals are abundant, and quartz, augite, and biotite are present locally. In composition the ignimbrites range from rhyolites to dacites and are distinctly sodic, and may be from the gas-charged upper part of a granitic magma intruding into the pre-existing lower part of the Harbour Main Group; the lower, gas-poor part of the magma may have formed the present discordant "Holyrood batholith" of the Avalon Peninsula. — HRC

Parker, Mary C. *See* Dorheim, Fred H. 06929

Parker, Patrick L. *See* Attaway, David H. 06830

Parker, Ronald B. *See* Goodwin, Jonathan H. 06709

07049 **Paterson, W. S. B.** The Meighen Ice Cap, Arctic Canada — Accumulation, ablation and flow [with French and German abs.]: Jour. Glaciology, v. 8, no. 54, p. 341-352, illus., tables, 1969.

Meighen Icecap is an example of a type of Arctic icecap that shows no sign of past or present movement. Accumulation on Meighen is about normal for the region but ablation is abnormally low. Statistical analyses of several years' data indicate that main trends are an increase in net balance with elevation and with distance from the south end of the icecap. Because ice movement is very small, the trends explain surface topography well. Studies of the rate of change of net balance with elevation indicate that the word "activity" should not be interpreted in terms of flow, and, alternatively, the activity index should be applied only to glaciers not far from a steady state, that is to glaciers in which rate of change of surface elevation with time is small compared to net mass balance; the Meighen Icecap would then be excluded. — VSN

06536 **Pearcy, David B.** New discoveries boost Rocky Mountain drilling: World Oil, v. 169, no. 5, p. 142-143, 154, illus., 1969.

Discovery of the prolific stratigraphically trapped "Muddy" (possibly the Lower Cretaceous Muddy Sand or Sandstone of F. F. Hintze, Jr.) has caused a surge of drilling activity in the southern half of the Powder River Basin in northeastern Wyoming. More than 20 percent of all Rocky Mountain drilling is centered in the southern portion of the Powder River Basin in the "Muddy" but new discoveries of several new pay zones is causing the drilling activity to move to the southeast. — GHD

Pederson, J. E. *See* Johnson, A. R., Jr. 06975

Pelton, P. J. *See* Burchfiel, B. C. 00028

06924 **Pemberton, H. Earl.** Supplement to California Division of Mines and Geology Bulletin 189 — Minerals of California for 1965 through 1968: Mineral Explorer, v. 3, no. 2, 62 p., 1969.

The last catalog of significant mineral occurrences in California, published in 1968, included all reported occurrences through December 1964. The Mineral Research Society of California will publish periodically information since that time. Minerals in this supplement are listed alphabetically, with occurrences listed by county; if the reported occurrence is supported by a published article, the reference is given. New minerals first discovered in California are: coalingite (1965), jennite (1966), nissonite (1966), and rosenhahnite (1967). Thirty-three species are listed from California for the first time, 59 species listed in Bulletin 189 have been discontinued (17 were discredited, 33 were discontinued for a variety of reasons), and 12 changes in species names are made. — MCM

06865 **Perez-Rosales, Candelario.** Simultaneous determination of basic geometrical characteristics of porous media: Soc. Petroleum Engineers Jour., v. 9, no. 4, p. 413-416, illus., 1969.

A statistical method for determining simultaneously some of the basic geometrical characteristics of porous media such as porosity, specific surface, mean pore width, mean grain thickness and absolute permeability is presented. The proposed method is characterized by its simplicity and the minimum amount of laboratory equipment that it requires. The experimental procedure used to evaluate the various geometrical characteristics is based upon the surface analysis of a sample. In view of this fact the applicability of the method is limited to homogeneous and isotropic materials. — Author's abstract

06907 **Perla, R.** Strength tests on newly fallen snow [with French and German abs.]: Jour. Glaciology, v. 8, no. 54, p. 427-440, illus., tables, 1969.

Modified versions of *in situ* strength tests previously applied to metamorphosed snow were developed to measure the mechanical properties of newly fallen snow during storm periods. A large drop-cone penetrometer, protected from wind by an aluminum shell, was used to determine snow "hardness". A lightweight model of the Haefeli ram penetrometer measured "ram numbers". Shear strengths were obtained from large, lightweight frames. Some preliminary tests were made with a shear vane driven by a torque wrench. A new technique was devised for measuring tensile strength whereby a cantilever test and the shear-frame test show high ratios for tensile to shear strength. Cantilever strength plotted against density shows an order of magnitude variation in strength at all densities. — Author's abstract

Perret, William R. *See* Sisemore, Clyde J. 07024

Perry, Barbara E. *See* Burger, H. Robert. 06860

06870 **Perry, Kenneth, Jr.** A computer program which computes the mode: Wyoming Univ. Contr. Geology, v. 8, no. 1, p. 9-17, illus., 1969.

The normative calculation assigns to each rock bulk chemical analysis a unique, simplified mineral assemblage. In experimental and natural rock systems, on the other hand, it is possible for two or more mineral assemblages to crystallize from the same bulk chemical analysis. This program is designed to compute this many to one correspondence between mineral assemblage and bulk chemical analysis under the assumption that the chemical compositions of the mineral phases in each assemblage are, a priori, known. — Author's abstract

Pert, G. J. *See* Clark, M. C. 07048

06937 **Pessagno, Emile A., Jr.** The Neosciadiocapsidae, a new family of Upper Cretaceous Radiolaria: Bulls. Am. Paleontology, v. 56, no. 253, p. 377-439, illus., 1969.

The Neosciadiocapsidae Pessagno, n. fam., include dicyrtid Nassellariina with helmet-shaped tests, nine cephalic skeletal elements, and a thoracic velum. A tubular structure, termed the *cephalopyle*, is usually present on the distal portion of the cephalis near the collar stricture (or in its absence, a vertical spine). The Neosciadiocapsidae display rapid faunal change during much of Late Cretaceous time. The family probably originated in the Jurassic and ultimately became extinct by

Eocene times. Twenty-one new species and nine new genera are described from the Upper Cretaceous portion of the Great Valley sequence of the California Coast Ranges. — *from* Author's abstract

00040 **Peterman, Zell E.; Carmichael, I. S. E.; Smith, A. L.** Sr^{87}/Sr^{86} ratios of Quaternary lavas of the Cascade Range, northern California: Geol. Soc. America Bull., v. 81, no. 1, p. 311-317, illus., tables, 1970.

Quaternary lavas from Mount Lassen, Mount Shasta, and Medicine Lake, which range in composition from olivine basalt to rhyolite, have Sr-87/Sr-86 values that fall between 0.7030 and 0.7043, corrected to 0.7080 for the Eimer and Amend (MIT) $SrCO_3$ standard. These values are very close to average (corrected) strontium isotopic values of some other circum-Pacific volcanic suites and of lavas of oceanic islands. The low ratios suggest a mantle origin. The notably high strontium content (1400 ppm) in the andesites from Mount Shasta also indicates a mantle origin at depths where plagioclase is absent as a stable phase in the residual material. — Authors' abstract

Peterman, Zell E. *See* Hedge, Carl E. 07014

Petersen, Ulrich. *See* Goodell, Philip C. 06707

06417 **Philip, J. R.** Hydrostatics and hydrodynamics in swelling soils: Water Resources Research, v. 5, no. 5, p. 1070-1077, illus., 1969.

The mathematical theory of water movement in unsaturated soils when applied to swelling soils involves: recognition that Darcy's law applies relative to soil particles, inclusion of the void ratio function in characterization of soil, and reconsideration of hydrostatics in swelling media. For swelling soils, the total potential includes the overburden potential, evaluation of which leads to the condition for equilibrium in the vertical. Three types of equilibrium profile follow: hydric, pycnotatic, and xeric. Other phenomena in swelling soils treated include steady vertical flows and unsteady horizontal and vertical flows. Classic concepts of ground-water hydrology, based on behavior of nonswelling media, fail completely for swelling soils. This approach also provides a theory of consolidation which includes soil particle movement, unsaturation, and self-weight. — *from* Author's abstract

Picard, M. Dane. *See* McCormick, C. D. 06528

06957 **Picard, M. Dane.** Oriented, linear-shrinkage cracks in Alcova Limestone Member (Triassic), southeastern Wyoming: Wyoming Univ. Contr. Geology, v. 8, no. 1, p. 1-7, illus., table, 1969.

These linear-shrinkage cracks are developed in microsparite and pseudosparite, possibly extending the range in depositional environments wherein such cracks have formed. Mainly straight, or slightly curved single cracks, there are also associated minor 2- and 3-segment ones. In 35 measured single cracks, lengths range up to 55 mm, widths to 6 mm, and length increases as width. Cracks penetrate beds 2 to 8 mm; crack-casts rise above bed surface 1 to 2 mm. Where associated with ripple marks cracks are parallel to crest strikes. Incompleteness is attributed to directional stress sufficient to overcome normal tendency of homogeneous, fine-grained material to form polygons through capillarity. Believed to have formed subaqueously, the cracks may have opened parallel to shoreline, or to paleostrike, because of slight downslope gravity movement of ooze, as was suggested for the Green River Formation cracks (Picard, 1966). — *from* Author's abstract

Pickett, George R. *See* Porter, Chris R. 06594

00027 **Pierce, William H.** A thermal speedometer for overthrust faults: Geol. Soc. America Bull., v. 81, no. 1, p. 227-231, 1970.

The energy released in gravity-driven overthrust faults goes almost entirely into heat. The peak temperatures attained depend upon the rate of movement and can be esti-

mated from mineralogical evidence. Exact mathematical analysis provides upper and lower bounds for movement duration. Calculated fault movement durations are typically lower bounded by times of several years. — AG

Pilkey, Orrin H. *See* Macintyre, Ian G. 06381

Pilkey, Orrin H. *See* Field, Michael E. 06824

Pimm, A. C. *See* Heezen, B. C. 06736

07005 **Piper, Arthur M.** Disposal of liquid wastes by injection underground — Neither myth nor millenium: U.S. Geol. Survey Circ. 631, 15 p., table, 1969.

For decades, volumes of unwanted oil-field brine have been injected; currently, liquid industrial wastes are being injected ever-increasingly, at a median depth of 2,660 feet; complex effects are not well understood, and space for this underground storage is exhaustible. Ranging widely in character and concentration, some wastes are incompatible one with another or with materials of the injection zone; some reactive or chemically unstable require pretreatment. For better planning and management, an immediate comprehensive canvass of the United States is proposed, to outline injection provinces according to their ability to accept waste, considering: natural ground-water circulation, regional hydrodynamics, safe injection pressures (and earthquake swarms), and geochemical aspects. Missouri, Ohio and Texas have specific statutes, other states impose diverse constraints; few have necessary staff skills, centralized authority, or financial resources. — GDC

Pitman, W. C. *See* Ewing, M. 06748

06531 **Pittman, Edward D.** Destruction of plagioclase twins by stream transport: Jour. Sed. Petrology, v. 39, no. 4, p. 1432-1437, illus., 1969.

In untransported material from granitic rocks A-twin/C-twin and Untwinned/Twinned ratios vary inversely with grain size. These characteristics persist in transported detritus. Plagioclase twins tend to be destroyed during stream transport as shown by an increase in the A-twin/C-twin and Untwinned/Twinned ratios. This is probably the result of breakage along composition and twin planes, and breakage of untwinned plagioclase into smaller grains. Because of these effects coarser grained plagioclase is preferred for provenance studies. — Author's abstract

Pohl, E. R. *See* White, William B. 00012

Pongsapich, Wasant. *See* Bockheim, James G. 06385

06594 **Porter, Chris R.; Pickett, George R.; Whitman, Walter W.** A statistical method for determination of water saturation from logs: Log Analyst, v. 10, no. 6, p. 3-10, illus., tables, 1969.

By the described method, a parameter P can be defined in terms of formation resistivity and porosity tool response. It is found that $P^{0.5}$ has a normal distribution for zones of 100 percent water saturation; for hydrocarbon bearing zones it has a different and unidentified distribution. No prior knowledge of water resistivity is required, nor of the cementation exponent, nor constants in the porosity tool response equation, provided these quantities are constants for the zones considered. A ratio can be defined in terms of the ranges of P values present, $R = 1$ for water saturated zones only and $R > 1$ for hydrocarbon zones; from these can be derived values of the resistivity index. Tested on various wells where zones were known from independent data including production histories, the techniques in all cases were successful in delineating hydrocarbon zones and provided proper values of water saturation. — *from* Authors' abstract

Poulos, Harry G. *See* Viggiani, Carlo. 00051

06943 **Presnall, D. C.** The geometrical analysis of partial fusion: Am. Jour. Sci., v. 267, no. 10, p. 1178-1194, illus., 1969.

During fractional fusion, crystal paths are continuous, but liquid paths frequently have compositional breaks corresponding to temperature intervals during which addition of heat causes no melting. Solidus fractionation lines define crystal paths followed during fractional fusion and can be used to deduce the corresponding liquid paths. Solidus fractionation lines may also be used to deduce crystal and liquid paths followed during equilibrium fusion. Many compositions that melt at peritectic or eutectic point, or on a boundary line would yield the same or nearly the same liquid composition even though wide variations in the amount of melting are permitted. This type of melting is suggested as a possible explanation for the large volumes of tholeiitic magma extruded on the continents and along ocean ridges. — *from* Author's abstract

Preston, Floyd W. *See* Davis, John C. 06776

06423 **Preston, Richard D.** Occurrence and quality of ground water in Shackelford County, Texas: Texas Water Devel. Board Rept. 100, 58 p., illus., tables, geol. map, 1969.

Permian rocks of the Wichita and Clear Fork Groups are found at the surface within Shackelford County, with Quaternary alluvial deposits along major streams; aquifers produce small amounts of water which occurs erratically in zones of generally low permeability on or near the outcrop. Sixty-seven percent of wells are completed in the Permian Lueders Formation and Quaternary alluvial deposits. Water quality varies widely; some wells contain water high in sodium, calcium, and chloride, and others in nitrate. Methods of disposal of oil-field brines are the probable cause of some of the poorer water quality. Most salt water produced with oil and gas is reported returned to the subsurface through injection and disposal wells. — *from* Author's abstract

06465 **Prokopovich, Nikola P.** Land subsidence along Delta-Mendota Canal, California [with German and French abs.]: Rock Mechanics, v. 1, nos. 2-3, p. 134-144, illus., tables, 1969.

About 40 miles of the lower reaches of the Delta-Mendota Canal in northwestern San Joaquin Valley are in an area affected by "deep" land subsidence. The phenomenon was not recognized and thus not taken into consideration in the design. From May 1953 to February 1966, subsidence along the canal locally exceeded 5-6 feet and concrete lining, pipe crossings, bridges, and other structures were flooded and locally submerged. The subsidence is caused by irrigation overdraft of the confined ground water. With canal delivery in 1951-53, the overdraft virtually ceased. Present subsidence is, therefore, essentially a progressively diminishing "lag" inherited from past overdraft. Ultimate amounts of lag were calculated from past subsidence records and found to vary from traces to 8.25 feet. — *from* Author's abstract

06495 **Pryor, W. A.; Hester, N. C.** X-ray diffraction analysis of heavy minerals: Jour. Sed. Petrology, v. 39, no. 4, p. 1384-1389, illus., 1969.

Techniques have been developed which yield reproducible results for X-ray diffraction analysis of heavy mineral samples. Uniformity of grinding, orientation of mounted mineral particles, mass absorption fluorescence, and textural character of heavy mineral grains are the important, influential variables whose effects on X-ray diffraction analysis of heavy minerals have been determined and minimized. Heavy mineral samples can be grouped according to their gross diffraction patterns or diffraction "finger prints" which correspond to petrographic groups. X-ray diffraction analysis can be used as a routine, rapid, and supplementary method for analyzing large numbers of heavy mineral samples. — Authors' abstract

06539 **Pyle, Thomas E.; Antoine, John W.; Fahlquist, Davis A.; Bryant, William R.** Magnetic anomalies in Straits of Florida: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 12, p. 2501-2505, illus., 1969.

Seismic-reflection and magnetic profiles across three topographic highs in the western end of the Straits of Florida and southeastern Gulf of Mexico reveal the presence of diapiric structures which have magnetic anomalies greater than 1000γ. These deep-water knolls may be related to the volcanic-anomaly belt of the Florida

platform, the ultramafic rock outcrops of northwestern Cuba, or Cretaceous andesitic intrusive rocks of Yucatan and Florida. — Authors' abstract

Pyle, Thomas E. *See* Bryant, William R. 07033

06986 **Radbruch, Dorothy H.; Rogers, Thomas H.** Hayward and Calaveras fault zones, Field Trip 2A and 2B *in* 1969 field trips — Assoc. Eng. Geologists, Natl. Mtg., San Francisco, Calif., 1969: [Berkeley, Calif.] Assoc. Eng. Geologists, p. B1-B25, illus., 1969.

This is the road log for Field Trips 2A and 2B, which followed the route San Francisco-Gilroy-Hollister-Anderson Lake-Warm Springs - Fremont-Hayward-Oakland-San Francisco, to study traces of recent movement on the Hayward and Calaveras faults. In some places the fault zones are remarkably straight and very narrow, in others they are a wide band of en echelon or anastomosing fault traces. Faults known to be creeping are considered active, those showing physiographic evidence of having moved recently are considered dormant, and those with no evidence of recent movement are considered inactive. — DBV

06980 **Ragland, Paul C.** Alpha-autoradiography and morphology of accessory zircon suites: Southeastern Geology, v. 11, no. 1, p. 1-19, illus., tables, 1969.

Zircons were separated from five bentonites and a variety of other rocks, after which they were studied by α-autoradiography and standard petrographic techniques. Differences in elongation, rounding, and dispersion of size distributions were found to be useful to distinguish between the various zircon suites. Evidence is offered to demonstrate that: (1) zircons from the five bentonites are apparently from a homogeneous population; (2) U^{4+} and Th^{4+} can occupy regular lattice positions in zircon; and (3) zircons with complex crystal habits are in general smaller than those with less complex habits. Monazite or other highly radioactive impurities, which if present generally make up less than two percent of the zircon suite, can account for more than 50 percent of the radioactivity. — Author's abstract

Ragle, Richard H. *See* Bushnell, Vivian C. 06566

06913 **Randall, Charles A., Jr.** (editor). Extra-terrestrial matter: DeKalb, Ill., Northern Illinois Univ. Press, 331 p., illus., tables, 1969.

This conference, the third arranged and sponsored by Central States Universities, Inc., in cooperation with Argonne National Laboratory, the Atomic Energy Commission, and Associated Midwest Universities, reviews discoveries in geophysics, geochemistry and astrophysics at distances greater than one-earth radius. The six sections are: meteorites and tektites, lunar science, cosmic rays, cosmic rays and atmospheric neutrons, comets and interstellar dust, and a summary that is a transcript of a panel discussion by J. A. O'Keefe, E. Shoemaker, J. H. Patterson, and C. A. Randall. Three papers are cited separately. — MCM

00038 **Ray, Clayton E.; Denny, Charles S.; Rubin, Meyer.** A peccary, *Platygonus compressus* LeConte, from drift of Wisconsinan age in northern Pennsylvania: Am. Jour. Sci., v. 268, no. 1, p. 78-94, illus., tables, 1970.

A skeleton of the peccary, *Platygonus compressus* LeConte, was recovered from a borrow pit at Mosherville, Bradford County, northern Pennsylvania. The specimen was preserved in a well-bedded coarse sand, part of a kame of Olean Drift (of MacClintock and Apfel, 1944) of Wisconsinan age. A radiocarbon date of 11,900 ± 750 B.P. on rib fragments from the skeleton should be used with caution as a probable minimum date. This occurrence suggests that *P. compressus*, far from serving as an interglacial or southerly faunal indicator, may have ranged to within a few miles of the edge of the Wisconsinan ice sheet. — Authors' abstract

06674 **Raymond, G. P.** Consolidation of deep deposits of homogeneous clay [with French abs.]: Geotechnique, v. 19, no. 4, p. 478-494, illus., tables, 1969.

Under embankments and earth dams the load ratio will be greater than two to a depth of twice the embankment height. In deep deposits large variations in compressibility and permeability will occur throughout. In order to help account for these variations a theory and solutions are presented to cover a large number of practical problems involving one-dimensional drainage for a homogeneous soil. The theory presented often predicts large differences from rates of consolidation which might have been predicted from the assumptions of the standard linear theory. An approximate method of applying the theory to consolidation of soils by drain wells is presented. Two case records are referred to which show variation from linear theory predictions and could be accounted for by the theory presented. — *from* Author's abstract

Reasenberg, Paul. *See* Aki, Keiiti. 06886

00076 **Reed, Walter E.** Transport of water away from a buried heat source with special reference to hydrologic phenomena observed at Aardvark nuclear detonation: Jour. Geophys. Research, v. 75, no. 2, p. 415-430, illus., tables, 1970.

The structural relationship between thermoelectric and electrokinetic phenomena resulting from a thermal anomaly in geologic media is examined in detail using nonequilibrium thermodynamics. The following conclusions are advanced: (1) Detonation of an underground nuclear device establishes a thermo-electro-kinetic couple causing water flow radially away from the detonation site; this is considered to be the cause of hydrologic phenomena associated with the Aardvark event. (2) Electrical potentials established by the heat source will cause cations to migrate radially away from the anomaly; in the vicinity of a nuclear detonation, the migration rates are probably small. The phenomenological coefficients, which are pure functions of the geologic medium, should be routinely measured and evaluated whenever a situation involving a buried heat source is encountered. — DBV

06896 **Reid, John R.** Effects of a debris slide on "Sioux Glacier", south-central Alaska [with French and German abs.]: Jour. Glaciology, v. 8, no. 54, p. 353-367, illus., tables, 1969.

The lower one-third of "Sioux Glacier" was buried beneath a debris slide during the March 27, 1964, earthquake. Investigations of the effect on glacier regimen reveal that it has increased in thickness by as much as 28 m as a result of the insulating effect. In areas where debris has continuously veneered the surface, at least since 1938, the ice is also thicker. The area near the upper extent of the slide has become intensely crevassed and been lowered as much as 8 m between 1965 and 1966 while the terminal area is up to 5 m higher and is characterized by thrusting. It is concluded that a kinematic wave passed through this glacier between 1965 and 1966. The upper zone of debris-veneered ice is moving at 175 m per yr while the terminus is flowing at only 21 m per yr; the rate of down-glacier decrease is about 0.06 m per yr per meter of horizontal distance. — *from* Author's abstract

Reinking, Robert L. *See* Hagner, Arthur F. 06722

Renard, V. *See* Ewing, M. 06748

06407 **Resig, Johanna M.** Paleontological investigations of deep borings on the Ewa plain, Oahu, Hawaii: Hawaii Inst. Geophysics [Rept.] HIG-69-2, 99 p., illus., tables, 1969.

Depositional environments of reef limestones, soils, sands, and gray silt and mud of a 1,040-ft section overlying basal basalt flows are interpreted from the fossil content of two deep cores. Foraminiferal assemblages indicate accumulation of the fine clastics in a shallow lagoon. Brackish-water ostracodes and oyster layers indicate fluctuating salinity. Abraded condition of bryozoans is evidence of sediment transport. These shallow-water accumulations collectively require a subsidence of more than 1,000 feet. The modern aspect of the invertebrates and the absence of nannoplanktonic discoasters, as well as evidence of a long erosional interval at the base of the section, suggest a Pleistocene age, although the lowermost 150 feet may be late Pliocene. Fluctuations in sea level are shown by eight major faunal transgressions and regressions throughout the section. — VMJ

Reso, Anthony. *See* Johnson, J. G. 06430

Reynolds, J. H. *See* Hohenberg, C. M. 06999

Ribbe, P. H. *See* Brown, G. E. 07029

00007 **Rice, Alan.** A note on nonlinear effects in mantle convection: Jour. Geophys. Research, v. 75, no. 2, p. 491-494, table, 1970.

It is shown that dissipation may not safely be neglected in the description of a natural convection system; due to nonlinearity, its influence will be difficult to estimate without further calculation. Any description of a naturally convecting system that neglects dissipation is physically incorrect. Consideration of the effects of dissipation and volumetric heat sources suggests that low volumetric heat sources (2×10^{-16} cal per g per sec) can adequately drive continental drift. — DBV

Richards, Rowland, Jr. *See* Chowdhury, R. N. 00050

00016 **Richter, C. F.** Seismicity of the Earth: Nature, v. 225, no. 5228, p. 170, 1970.

As the monograph by Gutenberg and Richter (1954) on seismicity of the Earth recently has been reprinted without additions or corrections, attention is called to the need for caution in its use. The book may still be useful as a general guide for the student, but many earthquakes of importance have occurred since its publication, and the international improvement in seismological installations has led to better location of epicenters. Attention is drawn to recent works containing more up-to-date information. — DBV

Ritter, John R. *See* Brown, William M. 06743

Robertson, Forbes. *See* Tolman, Carl F. 06900

Robinson, Paul D. *See* Fang, J. H. 06821

06970 **Rocky Mtn. Assoc. Geologists; MacLachlan, James C.; Kleinkopf, M. Dean.** (editors, chairman). Configuration of the Precambrian surface of Colorado: Mtn. Geologist, v. 6, no. 4, p. 193-197, illus., geol. map, 1969.

Each area was compiled by a Research Committee member most familiar with it. In the deeper areas, higher horizons were contoured and depth to Precambrian was calculated from isopach maps; geophysical data was incorporated in some areas to further refine the surface. Topography developed on the Precambrian surface by successive geologic events serves to reflect major uplifts and depressions of the basement, and also depicts the influence of such large-scale structures on overlying sedimentary rocks. — ESL

Rogers, Leo A. *See* Sisemore, Clyde J. 07024

Rogers, Thomas H. *See* Radbruch, Dorothy H. 06986

Roller, J. C. *See* Eaton, J. P. 06793

06956 **Romero-Juárez, Antonio.** A note on the theory of temperature logging: Soc. Petroleum Engineers Jour., v. 9, no. 4, p. 375-377, illus., 1969.

One problem in injection wells is to determine the zones that are taking fluids. Temperature logging relates the injection flow rate to some characteristic of these logs. An empirically found factor of 6:1, explained theoretically, may be estimated more accurately. Typical temperature, microlog and spinner logs, and measured geothermal gradient and temperature log are shown of a Gulf Coast well injecting 3,000 bbl/day, in oolitic limestone of Jurassic age, in the San Andres oil field, Mexico. The average measured geothermal gradient was 0.0314°C/m or 0.0182°F/ft. Injecting and geothermal temperatures at 3,100-m depth are 51.5°C and 115.3°C, respectively. Measured injecting temperature gradient turns out to be 0.00875°C/m. At point of

interception of the two gradient lines, the tangent to this curve must be vertical. By this property the temperature profile may be better delineated when enough temperature readings are not available. — GDC

06982 **Romig, P. R.; Major, W. M.; Wideman, C. J.; Tocher, Don.** Residual strains associated with a nuclear explosion: Seismol. Soc. America Bull., v. 59, no. 6, p. 2167-2176, illus., table, 1969.

The BENHAM underground nuclear explosion at the Nevada Test Site (M = 3) was observed by two quartz-bar strain meters at 28 and 71 km from ground zero. Step-like residual strains of 1.8 and 0.35×10^{-7} were recorded. These results agree with those reported for earthquakes of M = 6.2 and also tend to substantiate the decay with distance law of $R^{-1.5}$ observed for earthquakes as opposed to the theoretical R^{-3}. A most significant observation was that, whereas earthquake steps do not decay within several days if at all, the strain step from BENHAM apparently decreased to near zero within half an hour. This decay with time appears to be a reflection of the pressure history of the cavity. — DBV

Rona, Peter A. *See* Brier, Chester. 06520

07028 **Rooney, Thomas P.; Jones, Blair F.; Neal, James T.** Magadiite from Alkali Lake, Oregon: Am. Mineralogist, v. 54, nos. 7-8, p. 1034-1043, illus., tables, 1969.

Magadiite ($NaSi_7O_{13}(OH)_3 \cdot 3H_2O$) has been identified in veins cutting playa sediments and in muds associated with alkali salts and brines at Alkali Lake playa, Oregon. Magadiite has apparently precipitated directly from solution, perhaps as a result of pH changes on dilution by runoff. The magadiite veins may be related to syneresis cracking in very fine-grained playa sediments derived from acid volcanics. — Authors' abstract

Rose, W. I., Jr. *See* Stoiber, R. E. 06412

06523 **Rosen, Norman C.** Heavy minerals and size analysis of the Citronelle Formation of the Gulf Coastal Plain: Jour. Sed. Petrology, v. 39, no. 4, p. 1552-1565, illus., table, 1969.

An East Gulf Province heavy mineral suite, typical of Cretaceous and Tertiary sediments, is present throughout the Citronelle and older Louisiana terrace deposits. A Mississippi River suite is present in the younger terrace deposits. The Citronelle appears to represent an alluvial apron formed by coalescing, braided streams in response to epeirogenic uplift of the continental interior during late Pliocene to preglacial Pleistocene times. Encisement of the Mississippi River and other streams into the Citronelle sediments has resulted in entrenched valleys containing fluviatile terraces which are mineralogically and lithologically similar to the Citronelle but are at lower elevations. Younger terrace deposits bearing a Mississippi River province heavy mineral suite are believed to have formed in response to fluctuating sea level during the Pleistocene. — *from* Author's abstract

06703 **Rosen-Spence, Andrée de.** Genèse des roches à cordiérite-anthophyllite des gisements cupro-zinciferes de la région de Rouyn-Noranda, Quebec, Canada [with French abs.]: Canadian Jour. Earth Sci., v. 6, no. 6, p. 1339-1345, illus., 1969.

Cordierite-anthophyllite-bearing rocks are found in alteration pipes below some of the copper-zinc deposits of the Rouyn-Noranda area that occur in Archean volcanics. The cordierite and anthophyllite have been developed around the contact of the Dufault granodiorite, by isochemical metamorphism of ripidolite of ancient alteration pipes of volcanic origin. — Author's abstract

06951 **Rosholt, J. N.; Bartel, A. J.** Uranium, thorium, and lead systematics in Granite Mountains, Wyoming: Earth and Planetary Sci. Letters, v. 7, no. 2, p. 141-147, illus., tables, 1969.

Uranium, Pb, and Th concentrations and isotopic compositions were determined on total rocks and a feldspar sample from widely separated parts of the Granite Mountains in central Wyoming. Linear relations defined by Pb-206/Pb-204 — Pb-207/Pb-204 and Pb-208/Pb-204 — Th-232/Pb-204 for the total rock samples define 2.8 billion-year isochrons. In contrast U-238/Pb-206 ages are anomalously old by a factor of at least four. Low U-238/Pb-204 values, coupled with the radiogenic Pb-206/Pb-204 and radiogenic Pb-207/Pb-204 ratios indicate that contents of uranium in near-surface rocks would have had to have been considerably greater than those presently observed to have generated the radiogenic lead. It is possible that more than 10^{11} kg of U was leached from near-surface rocks during the Cenozoic. — *from* Authors' abstract

06434 **Ross, Charles A.** Middle and Upper Pennsylvanian fusulinaceans, Gila Mountains, Arizona: Jour. Paleontology, v. 43, no. 6, p. 1405-1422, illus., table, 1969.

A late Paleozoic inlier on the southern flanks of the Gila Mountains contains a stratigraphic succession of Redwall Limestone, and Molas (60 feet), Horquilla (1000 feet), and Earp (60 feet) Formations. The Horquilla and Earp Formations here contain 22 species of Pennsylvanian fusulinaceans including two new species: *Triticites gilaensis* from the upper part of the Horquilla and *T. arcuosoides* from the Earp. A review of the taxonomic characters of Middle Pennsylvanian species of Fusulininae with internal construction similar to that of *Fusulinella girtyi* Dunbar and Condra (1927), leads to the recognition of *Beedeina* Galloway (1933) as a valid and useful generic taxon into which most North America species currently assigned to *Fusulina* are placed. — Author's abstact

Ross, S. H. *See* Jones, R. W. 06505

Rough, Robert L. *See* Overbey, William K., Jr. 07041

06977 **Royse, C. F., Jr.; Holland, F. D., Jr.** Type section for the Sentinel Butte Formation (Paleocene), western North Dakota [abs.]: North Dakota Acad. Sci. Proc. 1969, v. 23, p. 23, 1969.

Rubin, Meyer. *See* Ray, Clayton E. 00038

Ruch, R. R. *See* Kim, S. M. 06406

Russ, David P. *See* Burford, Arthur E. 06858

Ryan, William M. *See* Burford, Arthur E. 06858

06655 **Sainsbury, C. L.** Geology and ore deposits of the central York Mountains, western Seward Peninsula, Alaska: U.S. Geol. Survey Bull. 1287, 101 p., illus., 1969.

Ordovician carbonate rocks are thrust over slate and argillaceous limestone of pre-Ordovician age, which were intruded by gabbro in pre-Ordovician time. In Late Cretaceous time, stocks of biotite granite, and dikes of rhyolite, granite, porphyry and lamprophyre were intruded into the thrust plates. Still later, ore deposits of tin, beryllium and fluorite were formed where normal faults ruptured uncooled granites. Ten ore bodies were localized near granites, but beryllium-fluorite lodes were localized where lamprophyre dikes intersected porous zone along thrust faults. Regionally, the beryllium deposits are zoned about the tin deposits. Studies of trace elements in rocks, ores, and minerals of the district show that granites are enriched in metals common in the ore deposits, and that the lamprophyre dikes are mafic rocks contaminated by granite. — CLS

Salotti, C. A. *See* Giardini, A. A. 06441

06934 **Saucier, R. T.** Selected geologic literature, Lower Mississippi Valley Division area, index and annotated bibliography: U.S. Army Corps Engineering Waterways Expt. Sta. Tech. Rept. 3-712, supp. 3 (supersedes supp. 2), [78] p., 1969.

Approximately 50 references to published and unpublished items of geologic literature have been evaluated and annotated since publication of Supplement 2 in 1968. The new references have been combined with those in the previous supplements using a magnetic-tape-based system and are presented in this report, which supersedes the previous supplements. Appendix A lists items not indexed on maps, and Appendix B those indexed on maps. — MCM

Sauer, Herbert I. *See* Shacklette, Hansford T. 00002

06414 **Scalf, Marion R.; Dunlap, William J.; McMillion, Leslie G.; Keeley, Jack W.** Movement of DDT and nitrates during ground-water recharge: Water Resources Research, v. 5, no. 5, p. 1041-1052, illus., 1969.

A field investigation of the fate of DDT and nitrates artificially recharged into the Ogallala aquifer [High Plains area, Texas and New Mexico] was done by two Government agencies. Following 10 days of recharge, the well was pumped for 12 days. During the recharge, nitrates moved at the same rate as recharge water, but DDT was adsorbed to the aquifer near the recharge well. During pumping, 94 percent of recharge water and nitrates was recovered. Apparently a major portion of DDT introduced during recharge was not recovered but remained in the aquifer. — *from* Authors' abstract

06940 **Schairer, J. Frank.** Leason Heberling Adams [1887-1969]: Am. Jour. Sci., v. 267, no. 10, p. 1256, 1969.

Schlicte, A. Kenneth. *See* Bockheim, James G. 06385

06880 **Schlocker, Julius.** San Francisco Peninsula, Field Trip 3 *in* 1969 field trips — Assoc. Eng. Geologists, Natl. Mtg., San Francisco, Calif., 1969: [Berkeley, Calif.] Assoc. Eng. Geologists, p. C1-C17, illus., 1969.

This is the road log for Field Trip 3, which observed numerous examples of the relationships of geology to land use along a route from San Francisco to the Mission Swamp subsiding area, Bayshore Freeway, Redwood Shores, Palo Alto, Stanford Linear Accelerator, San Francisco fault zone, Woodside, Redwood City, Pulgas Water Temple, Crystal Springs Reservoir, City College fault zone, San Bruno Mountain, and Twin Peaks. — DBV

Schloffman, Steven. *See* Gibbons, John F. 07013

06673 **Schmertmann, J. H.** Swell sensitivity: Geotechnique, v. 19, no. 4, p. 530-533, illus., tables, 1969.

Some clays significantly increase their swell behavior when subjected to repeated large shear strains of mechanical remoulding. This phenomenon is here termed "swell sensitivity" and is expressed quantitatively by the ratio of swelling index remoulded/swelling index undisturbed. An example is cited of the importance of knowledge of the swell sensitivity at a foundation site in Gainesville, Florida — VSN

Schmidt, A. W. *See* Burke, Jack A. 06596

00065 **Scholl, David W.; vonHuene, Roland.** Comments on paper by R. L. Chase and E. T. Bunce, "Underthrusting of the eastern margin of the Antilles by the floor of the western North Atlantic Ocean, and origin of the Barbados ridge" [1969]: Jour. Geophys. Research, v. 75, no. 2, p. 488-490, illus., 1970.

Chase and Bunce (ibid., v. 74, no. 6, p. 1413-1420, 1969) suggested that structures along three reflection profiles which would be diagnostic of converging plates have been acoustically hidden by slumping of sediments into the trench. This possibility was considered by Scholl and von Huene in another connection but abandoned, for reasons which are given here. Further, the decollement models previously proposed by Scholl and von Huene are now thought to be substantially incorrect representatives of the style of deformation that might be expected at the juncture of converging plates. — DBV

06568 **Scholz, C. H.; Fitch, Thomas J.** Strain accumulation along the San Andreas Fault: Jour. Geophys. Research, v. 74, no. 27, p. 6649-6666, illus., table, 1969.

Analysis of geodetic data (geodimeter and triangulation) indicates that nearly pure shear with a maximum shear plane nearly parallel to the fault is accumulating at a rate of about 0.7×10^{-6} per yr along the San Andreas fault from San Francisco to the Transverse Ranges. The nearly east-west trending segment of the fault in the Transverse Ranges is accumulating nearly uniaxial compression normal to the fault at a rate of 1.1×10^{-6} per yr. It is thought that fault creep and small earthquakes are not substantially releasing the accumulating strain. More complete data in the Imperial Valley suggest even greater strain accumulations, the release of which is not accounted for by small earthquakes and creep. It is suggested that strains at greater depths are being relieved by aseismic slip or inelastic deformation. — GV

06873 **Schram, Frederick R.** The stratigraphic distribution of the Paleozoic Eumalacostraca: Fieldiana — Geology, v. 12, no. 13, p. 213-234, illus., table, 1969.

Stratigraphic ranges (Middle Devonian-Upper Permain) are plotted for all species and higher taxa of Paleozoic Eumalacostraca described in the literature. The classification system follows that used by H. K. Brooks (1962, Paleozoic Eumalacostraca of North America). Graphic distribution of the numbers of species and higher taxa are shown for the same stratigraphic interval; discrepancy between number of species described in the literature and number of species after probable synonyms are eliminated is greatest in the Mississippian, least in the Pennsylvanian, which marks the peak of diversity in the higher taxa. In the body of the text, grouped under headings of major stratigraphic and taxonomic divisions, horizons, localities, and synonymies of species are briefly noted. A comprehensive reference list is appended. — VMJ

06874 **Schram, Frederick R.** Some Middle Pennsylvanian Hoplocarida (Crustacea) and their phylogenetic significance: Fieldiana — Geology, v. 12, no. 14, p. 235-289, illus., tables, 1969.

Three new genera and species of hoplocarids are described. *Kallidecthes richardsoni* from the Essex fauna of the Mazon Creek area, northeastern Illinois, and *Aratidecthes johnsoni* from the slightly older Mecca fauna of the Logan Quarry shale, Parke County, Ind., are placed in a new family of a new order, Aeschronectida. *Tyrannophontes theridion*, from the Essex fauna, is placed in a new family of a new suborder, Archaeostomatopodea of the order Stomatopoda; a second new suborder is erected for the other families of stomatopods, Jurassic to living. The Eumalacostraca are considered polyphyletic, with the hoplocarids and the caridoid Eumalacostraca evolving from the Leptostraca in at least two separate lines. — VMJ

Schreiber, E. *See* Fox, P. J. 06809

06960 **Schreiber, Edward.** The effect of solid solutions upon the bulk modulus and its pressure derivative — Implications for equations of state: Earth and Planetary Sci. Letters, v. 7, no. 2, p. 137-140, illus., 1969.

Following Liu, equations relating the bulk modulus and its derivatives with composition for systems in which solid solution occurs are presented. It is shown that these equations adequately represent the available data for the system $MgAl_2O_4$-γ-Al_2O_3, and α-Al_2O_3-α-Cr_2O_3. The important equation of state parameters K and dK/dP (bulk modulus and its pressure derivative) may be computed from data available for any two compositions in a solid solution. Using these equations and available data, these parameters have been calculated to be K = 1.36 mbar and dK/dP = 1.8 for fayalite. — Author's abstract

06377 **Schroeder, W. L.; Schuster, R. L.** Laboratory simulation of seismic activity in saturated sands, *in* Vibration effects of earthquakes on soils and foundations — ASTM, 71st Ann. Mtg., San Francisco, 1968, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 450, p. 57-70, illus., tables, 1969.

Disturbances are produced by employing a device which includes, among other components, a standard triaxial cell of proper piston-sample diameter ratio and a cell pressure changing mechanism. Recorded responses of the specimens are summarized to establish the effects of several important variables on the tendency of sand for liquefaction and on observed deformations. Among the factors considered are initial void ratio, relative density, and initial stress conditions. It is shown that initial shearing stresses are significant in their effect on pore pressure responses. The results are compared with those of other investigators and with observations of naturally occurring phenomena to evaluate the validity of the tests. — *from* Authors' abstract

06877 **Schultz, Leonard G.** Lithium and potassium absorption, dehydroxylation temperature, and structural water content of aluminous smectites [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 17, no. 3, p. 115-149, illus., tables, 1969.

Validity of the Greene-Kelly (1955) Li^+-text for distinguishing between montmorillonite and beidellite, factors controlling expansion characteristics when the minerals are K^+-saturated, and factors that control their different thermal characteristics are evaluated using analyses of 83 samples. Wyoming-type montmorillonites have a low net layer charge and re-expand to 17 A; other montmorillonites and beidellites have a higher net layer charge and re-expand to less than 17 A. Major factor controlling temperature of dehydroxylation is amount of structural (OH). Montmorillonites and one ideal beidellites giving dehydroxylation endotherms on DTA curves between 650° and 760°C contain nearly the ideal amount of 4(OH) per unit cell, but nonideal samples giving peaks between 550° and 600°C do not. Nonideal beidellites contain more than the ideal amount of structural (OH) and nonideal montmorillonites contain less. — ESL

Schuster, R. L. *See* Schroeder, W. L. 06377

06535 **Schwab, Frederic L.** Cyclic geosynclinal sedimentation — A petrographic evaluation: Jour. Sed. Petrology, v. 39, no. 4, p. 1325-1343, illus., tables, 1969.

A composite Cordilleran geosynclinal sedimentary section in western Wyoming reveals striking vertical changes in mineralogy. Mica, cement, and matrix exhibit systematic upward changes in composition, but not in abundance. Feldspar is rare except in certain Cretaceous sandstones. Lithic fragments increase in abundance upward and exhibit orderly changes in composition. Paleozoic sandstones are rich in harder lithic clasts; younger sandstones contain softer fragments. Systematic changes support the cyclical sedimentation concept in geosynclines, and specific changes in composition reinforce and modify published conclusions about dispersal systems, source areas, and tectonism in time and space relative to particular geographic areas. — *from* Author's abstract

Schwarcz, H. P. *See* Clarke, W. B. 00008

Schwarcz, Henry P. *See* Grootenboer, Johan. 06965

00073 **Sclater, J. G.; Mudie, J. D.; Harrison, C. G. A.** Detailed geophysical studies on the Hawaiian arch near 24°25′ N., 157°40′ W. — A closely spaced suite of heat-flow stations: Jour. Geophys. Research, v. 75, no. 2, p. 333-348, illus., 1970.

Twelve heat-flow measurements, ranging from 0.33 to 1.43 μcal per sq cm per sec, with a mean of 0.98 μcal per sq cm per sec, were made during a survey of a 20 × 20 km area near the Hawaiian arch crest. As the normal and subnormal values preclude a credible explanation of the scatter of heat flow based on the effects of recent volcanism, doubt is cast upon the validity of interpreting the surface field from widely separated observations. A deeply towed instrument package provided detailed information on the local environment which ruled out the possibility that much of the local scatter may be caused by previously undetected ocean floor relief. The scatter can be explained by refraction of the heat flux by irregularities in the sediment cover and the effect of recent slumps from a nearby sediment-covered ridge. — *from* Authors' abstract

Scott, R. B. *See* Moores, E. M. 00018

Scott, S. D. *See* Barnes, H. L. 06835

Scott, W. B. *See* Hornby, M. R. 06510

Seed, H. B. *See* Thiers, G. R. 07036

06692 **Seguin, Maurice.** Configuration et nature du mode tectonique en bordure ouest de la partie centrale de la fosse du Labrador [with French abs.]: Canadian Jour. Earth Sci., v. 6, no. 6, p. 1365-1379, illus., tables, 1969.

This paper deals with the use of geophysical methods to look for magnetic taconites in central part of the Labrador Trough and to study the tectonic style of the western margin of the Labrador Trough. The tectonic model that best fits the geophysical information obtained is a decollement which took place between the Proterozoic sediments and the stable crystalline Archean complex. — Author's abstract

Seifert, K. E. *See* Gross, B. 06716

Semken, Holmes A., Jr. *See* Straka, Joseph J., 2d. 06435

07002 **Senftle, F. E.; Thorpe, A. N.; Sullivan, S.** Magnetic properties of microtektites: Jour. Geophys. Research, v. 74, no. 27, p. 6825-6833, illus., tables, 1969.

The magnetic susceptibility, magnetization, and Curie constants were measured for 17 normal and 11 bottle-green microtektites found in deep-sea sediment cores. The normal microtektite specimens had a significant intensity of magnetization which was ascribed to a ferromagnetic iron oxide film on the surface of the microtektites and which can be removed by acid leaching. The bottle-green microtektites showed properties similar to the normal variety before leaching. Although the leaching process did not affect the bulk iron content of the normal microtektite glass, it was possible to remove all iron from the bottle-green glass. The solubility indicates that the bottle-green specimens may have been partially reacted with the sea water, thus altering their original properties. — GV

Sever, J. *See* Behrens, E. W. 06840

00002 **Shacklette, Hansford T.; Sauer, Herbert I.; Miesch, A. T.** Geochemical environments and cardiovascular mortality rates in Georgia: U.S. Geol. Survey Prof. Paper 574-C, p. C1-C39, illus., tables, 1970.

Nine contiguous counties of northern Georgia that have a low cardiovascular mortality rate lie in an area where the rocks continuously contribute minor elements to the soil; nine counties of central and south-central Georgia, in contrast, have a high death rate from cardiovascular causes and lie in an area where soil-forming materials are deficient in these elements. Analyses of soils and tree samples indicate that the geochemistry of the two areas is significantly different, northern Georgia having minor elements in greater abundance. Although most vegetables do not reflect this difference, the soil elements may enter the human food chain in other plants, in water, and in locally-produced meat and milk. If geochemical differences contribute to cardiovascular mortality differences, the effects most likely are through a dietary deficiency, rather than an excess, of minor elements. — HTS

Shane, K. C. *See* Clarke, W. B. 00008

Shane, Lemay E. *See* Guyod, Hubert. 06647

00064 **Shankland, T. J.** Pressure shift of infrared absorption bands in minerals and the effect on radiative heat transport: Jour. Geophys. Research, v. 75, no. 2, p. 409-413, illus., 1970.

The pressure shift of the Fe^{2+} absorption band at 1μ has been measured to 40 kb in olivine and MgO. The pressure coefficients are 1.6×10^{-2} cm^{-1}/bar for olivine and 0.7×10^{-2}cm^{-1}/bar for MgO. Although the shift is in a direction to open up the transmission window in the near infrared for radiative heat transport, it is shown that the mag-

nitude of the shift is much less than the thermal broadening of the band under upper mantle conditions of temperature and pressure. Thus the conclusions drawn from high temperature measurements alone, that radiative conductivity is not a dominant heat transfer mechanism in the upper mantle, continue to hold when the effect of pressure is included. — Author's abstract

06689 **Shaw, Denis M.; Gibson, Shirley M.** Calculation of the diopside-fluorite eutectic using ionic models — Comments on 'The system CaF_2-$CaMgSi_2O_6$' [by S. B. Lin and B. J. Burley, 1969]: Canadian Jour. Earth Sci., v. 6, no. 6, p. 1458-1460, illus., table, 1969.

Five models of the liquid state have been used to calculate the liquidus curves and the eutectic point in the simple binary system diopside-fluorite. None predicts adequately the recent experimental results of Lin and Burley [ibid., v. 6, p. 269-280, 1969]. — Authors' abstract

06497 **Sheridan, R. E.; Smith, J. D.; Gardner, J.** Rock dredges from Blake escarpment near Great Abaco Canyon: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 12, p. 2551-2558, illus., table, 1969.

Lower Cretaceous (Neocomian-Albian) shallow-water algal and foraminiferal limestones were recovered from the base of the Blake escarpment in water depths of 4,200-4,780 m. Tertiary (Pliocene and Paleocene) pelagic foraminiferal calcilutites were dredged from the upper lip (1,470-1,620 m) of the escarpment and canyon, where the Tertiary section appears to be only 150 m thick. Fossil and stratigraphic correlations imply that a Neocomian-Aptian algal-reef formation was once continuous between Great Abaco Canyon and the Blake nose and that this platform has subsided as much as 4,500 m. This net subsidence appears similar to that found for Andros Island in the Bahamas, but is not comparable in detail to that in the Blake nose area. The latter difference may be explained by possible faulting between the canyon and the nose. — Authors' abstract

06661 **Sherif, M. A.; Bostrom, R. C.** Studies of the soil mechanics of ocean floors: Trend Eng., v. 21, no. 4, p. 27-30, illus., 1969.

Soil mechanics is being applied to problems of the ocean floors in investigations underway in the Department of Civil Engineering [University of Washington, Seattle]. Numerous opportunities are available for further work. Offered as an example of engineering applications being made is a rheological model used to assess creep stability, long-term strength, and viscoelastic behavior of oceanic sediments. — Authors' abstract

06458 **Short, Nicholas M.** Physical, chemical, and optical changes in intensely shocked "basalt" from the DANNY BOY Nuclear Crater [abs.]: Meteoritics, v. 4, no. 3, p. 206-207, 1969.

Silver, L. T. *See* McGetchin, T. R. 00067

Silver, Leon T. *See* Anderson, Thomas H. 06828

00004 **Silverman, Daniel.** Seismic holography — Oil-finding tool of the future: Ocean Industry, v. 5, no. 1, p. 40-43, illus., 1970.

The new optical method invented for recording and producing, without lenses, a three-dimensional image of an object is called optical holography or lensless photography and depends on the use of coherent light, a precisely constant single frequency of light (laser beam). Since coherent elastic waves can be generated in the earth, it should be possible to create an elastic-wave holographic system which would be of potential use in search for oil. Two main areas of application of the principles of elastic-wave holography are in surveillance of oceans and mapping the internal structure of the Earth; other possible applications would be for imaging small mechanical structures in the seas, particularly in murky waters. The application to oil exploration is illustrated here for measurements made on the Earth's surface. Comparisons are made with conventional seismic methods. — VSN

00068 **Silverman, S. M.** On the thermal expansion and contraction of quartz: Jour. Geophys. Research, v. 75, no. 2, p. 406-408, illus., 1970.

The thermal expansion and contraction of quartz in the neighborhood of the $\alpha \rightarrow \beta$ transition is treated as a cooperative phenomenon. This approach is shown to be consistent with the observed behavior, and a potential barrier of 24 kcal per mole is deduced. The results are consistent with a previous treatment of the specific heat data by a similar approach. — Author's abstract

Simmons, Gene. *See* Horai, Ki-iti. 00015

Simmons, Gene. *See* Nur, Amos. 06556

06643

06664 **Simmons, Gene; England, Anthony W.** Universal equations of state for oxides and silicates: Physics Earth and Planetary Interiors, v. 2, no. 2, p. 69-76, illus., tables, 1969.

Several relations among elastic properties, density, and mean atomic weight are examined on the basis of experimental data now available for oxides and silicates. Although the relations of Birch, O. Anderson-Nave, and D. Anderson are useful for geophysical interpretation of the Earth and other planets, there are many exceptions and none of the relations appear to have general validity. — *from* Authors' abstract

06650

Simmons, Gene. *See* Nur, Amos. 06955

Simmons, Gene. *See* Nur, Amos. 06963

06549 **Simpson, G. G.** On the term brachydont: Systematic Zoology, v. 18, no. 4, p. 456-458, 1969.

Objection is made to the adoption by Sondaar (1968) of the term *chtamalodont* introduced in a thesis by Korenhof in 1960, for low-crowned teeth as opposed to hypsodont, instead of brachyodont which should be used opposite dolichodont. Misspellings cloud the Greek origins of these words; priority may be found in the use of "-brachyodontism" by Hrdlicka (1923) and definition of "brachydont" (Nelson et al, 1947). The first is derived from a word spelled with theta, meaning "near or on the ground", which can be rendered "low"; but it is virtually unpronounceable, and in application to low-crowned teeth is less appropriate than *brachy-*. (The genus *Chthamalus* is a barnacle!). There is ample authority and etymological justification for both spellings of brachydont, depending on retention of the first *o* in *-odont*, the shorter the better. The apparent parallel with *hypso-* is spurious. "Brachiodont" in Sonaar (1968), presumably a misprint, would mean "arm-toothed". — GDC

0664

06954 **Sinha, A. K.** Removal of radiogenic lead from potassium feldspars by volatilization: Earth and Planetary Sci. Letters, v. 7, no. 2, p. 109-115, illus., tables, 1969.

0658

Isotopic compositions of leads were determined in three fractions of potassium feldspars from granitic rocks and pegmatites: the bulk material; a fraction of lead, usually 1/3 the total amount, removed by volatilization; and the lead remaining in the sample after volatilization. In some cases, the isotopic compositions were identical in all three fractions, while in others, lead was more radiogenic in the volatile fraction and less radiogenic in the residual than in the bulk sample. In most, the isotope composition in homogeneous samples agreed with that in coeval galenas. In samples with heterogeneously-dispersed-radiogenic lead, the composition in residual samples agreed more closely with that in galenas. In some samples, residual lead had a composition nearly identical to that of galenas even though the bulk-sample lead was more radiogenic. Radiogenic lead may be heterogeneously distributed in sites in K-feldspars where less strongly bound. — *from* Author's abstract

0651

Sirkin, Leslie. *See* Gill, Harold E. 06747

07024 **Sisemore, Clyde J.; Rogers, Leo A.; Perret, William R.** Project Sterling — Subsurface phenomenology measurements near a decoupled nuclear event: Jour. Geophys. Research, v. 74, no. 27, p. 6623-6637, illus., tables, 1969.

The purpose of the Sterling event, a 380-ton nuclear explosion detonated in a spherical cavity, was to test the decoupling theory for nuclear explosives detonated in explosively generated cavities. Measurements of stress history, cavity pressure, and cavity collapse were attempted in the region from 17 to 52 m from the center; free-field measurements of particle velocity and acceleration were made in the region from 52 to 660 m. Peak accelerations measured over this interval ranged from 150 to 0.2 g; peak velocities ranged from 0.13 to 0.01 m per sec. A free-field decoupling ratio of about 100 for a frequency range near 10 Hz was obtained. Above 10 Hz, the decoupling ratio drops rapidly at about 20. These results are in reasonably good agreement with the decoupling theory. — *from* Authors' abstract

06439 **Skinner, John W.; Wilde, Garner L.** *Pseudofusulina californica*, new name for *Pseudofusulina tenuis* Skinner and Wilde: Jour. Paleontology, v. 43, no. 6, p. 1441, 1969.

Pseudofusulina californica is proposed to replace *P. tenuis* Skinner and Wilde, 1965, which is a homonym of *P. tenuis* Chen, 1934. — RCD

Skinner, W. R. *See* Bowes, D. R. 06848

06504 **Slosson, James E.** Engineering geology as related to highway design and construction and the considerations that should be given to adjacent real estate, *in* Engineering geology and soils engineering symposium, 7th Ann., Moscow, Idaho, 1969, Proc.: Boise, Idaho, Idaho Dept. Highways, p. 48-60, illus., 1969.

In many areas of the United States the population tide has forced the utilization of regions previously considered to be open space, and these regions often possess unfavorable geologic and topographic environmental elements. Highway designs for this type of terrain in general have evolved from flatland concepts, and in many cases little consideration has been given to the geologic environment; this often has had considerable impact on the value of adjacent real estate. Many examples can be given of highways constructed in rugged terrain where considerable acreage of potentially very valuable property has been involuntarily condemned or, at best, has reverted to nonresidential use. — DBV

Smith, A. L. *See* Peterman, Zell E. 00040

Smith, Alan R. *See* Wollenberg, Harold A. 00075

Smith, J. D. *See* Sheridan, R. E. 06497

06641 **Smith, Jay L.** Investigations into the probability of surface faulting [abs.], *in* Engineering geology and soils engineering symposium, 7th Ann., Moscow, Idaho, 1969, Proc.: Boise, Idaho, Idaho Dept. Highways, p. 222, 1969.

06583 **Smith, W. D. M.** Log density, porosity: Oilweek, v. 20, no. 44, p. 24-25, 28-29, illus., tables, 1969.

Data were available from seven western Canada basins for appraisal of log density-core porosity relationships in sandstones, limestones, and dolomites. The response curves are plotted for each reservoir, and discussed according to rock types. Three were sandstone; limestones were restricted to two wells in the same reservoir; and there were three dolomite reservoirs. The log density, porosity relations are more useful for sandstone evaluation than are acoustic traveltime; for carbonates, log density relationships were not as useful as acoustic traveltime. — ESL

06584 **Smith, W. D. M.** Acoustic logs and porosity: Oilweek, v. 20, no. 39, p. 23-24, 26, illus., 1969.

Results of traveltime-porosity correlation show that useful relationships can be established for most western Canada reservoirs. Acoustic traveltime response in sandstones is discussed by considering effects of cement type, depth, consolidation, and shaliness. There is a narrow response spectra over all ranges of limestone and dolomite porosity. Equations can be established for each of these rock types with greater confidence than for sandstones. — ESL

Smith, W. E. *See* LaMoreaux, P. E. 06649

06478 **Snetsinger, Kenneth G.; Keil, Klaus.** Ilmenite in ordinary chondrites: Am. Mineralogist, v. 54, nos. 5-6, p. 780-786, illus., tables, 1969.

Chondritic ilmenite has the compositional range TiO_2 51.0-54.4, FeO 35.4-44.6, MgO 1.5-6.6, MnO 0.6-9.8, Cr_2O_3 0.03-1.40 wt percent. Average structural formula is $(Fe_{1.75}Mg_{0.23}Mn_{0.02})(Ti_{1.96})O_6$. For "equilibrated" chondrites, iron content of ilmenite tends to increase from H- to L- to LL-group chondrites; magnesium and manganese have a reverse tendency. Because iron and magnesium variation is the same as observed in pyroxene, olivine, and chromite of "equilibrated" chondrites, it is suggested that ilmenite is in equilibrium with these. Owing to rarity of ilmenite in ordinary chondrites, insufficient data are available to detect trends and, therefore, a primary igneous or metamorphic mode of equilibration cannot be distinguished. — *from* Authors' abstract

06671 **Soc. Paleontologica Italiana.** Angelina R. Messina, 1910-1968: Soc. Paleont. Italiana Boll. 1967, v. 6, no. 2, p. 217, 1969.

Sohl, Norman F. *See* Owens, James P. 06474

07026 **Sörensen, Henning; Hansen, John; Bondesen, Erling.** Preliminary account of the geology of the Kvanefjeld area of the Ilímaussaq intrusion, South Greenland: Grönlands Geol. Undersögelse Rap. 18, 40 p., illus., tables, geol. maps, 1969.

The area, in the northernmost part of the Ilímaussaq intrusion, represents a section through the roof zone of the intrusion, composed of sandstone, basaltic lavas, sheets of gabbro, dikes of dolerite and trachyte, and large masses of anorthosite. Oldest members of the intrusion are augite and alkali syenites, which with large masses of naujaite, are enclosed in fine-grained lujavrites. The latter also intrudes lavas of the roof, causing local enrichment in epistolite-murmanite minerals. The latest member of the intrusion is a coarser-grained lujavrite forming sheets and veins in the other rocks, producing concentrations of steenstrupine, monazite, and thorite(?), and may contain 0.3 percent uranium, and several times as much thorium. Analcime-rich veins rich in niobium and beryllium are widespread. — *from* Authors' abstract

06588 **Southern Interstate Nuclear Board.** Uranium in the southern United States — U.S. Atomic Energy Comm. Rept. WASH-1128: Washington, D.C., U.S. Govt. Printing Office, 230 p., illus., tables, 1969.

All known occurrences of uranium and some references to thorium in a 17-state area are cataloged and evaluated as potential sources of uranium in the southern United States, where uranium has been neglected partly because of complex geology, dense vegetation, and remote location with respect to productive areas. Known commercial deposits are chiefly in Texas, with some in Oklahoma. The largest known resources are in the black shales of Tennessee, Alabama, Georgia, Kentucky, Oklahoma and other states, but deposits are low grade. Most likely areas (not explored adequately) are in continental sandstone or sand. Summary information is given for Alabama, Arkansas, Missouri, Oklahoma, Delaware, Maryland, Florida, Georgia, Kentucky, Louisiana, Mississippi, North and South Carolina, Tennessee, Texas, Virginia, and West Virginia. — MCM

06464 **Spaine, Suzanne I.** Base- and precious-metal and related deposits of Alabama: Alabama Geol. Survey Circ. 55, 94 p., illus., 1969.

Pyrite, copper, gold, arsenic, silver, tin, and barite have been mined in Alabama. Pyrite and copper are found in the Hillabee Chlorite Schist, a highly metamorphosed rock. Gold is found in association with quartz, either in veins or lenses in metamorphic and igneous rocks, and in placer deposits derived from these lodes. Arsenic and silver are found in small quantities, mostly in association with gold deposits. Tin is found as cassiterite in metamorphic rocks or pegmatites, almost exclusively in Coosa County. From 1914 to 1925, barite was mined from residual deposits or veins in sedimentary rocks of the Valley and Ridge province, or from veins in schists of the Piedmont province. Most other mineral deposits were worked prior to the 1900's. In

this report, 222 mines and prospects are described; a map shows the location of 215 of the deposits. — *from* Author's abstract

06577 **Spiess, Fred N.; Luyendyk, Bruce P.; Larson, Roger L.; Normark, William R.; Mudie, John D.** Detailed geophysical studies on the northern Hawaiian Arch using a deeply towed instrument package: Marine Geology, v. 7, no. 6, p. 501-527, illus., 1969.

A 20 by 20 km area at 24° N. 157°40′ W. near the crest of the Hawaiian Arch was surveyed. Narrow-beam, near-bottom echo soundings show the east-west trending ridge in the southern portion to be flanked by grabens about 500 m wide and 50-60 m deep. The rest of the area is rolling ahd lobate. A shape similar to a subaerial lava dome was mapped on the northern flank of the ridge. The ridge results from a combination of volcanic and tectonic processes that uplifted and tilted several hundred meters of the pre-existing sediments. Conventional reflection profiles and near-bottom side-looking sonar surveys suggest that volcanic material has been extruded on the sediment-covered floor and intruded into the sedimentary column. Magnetic data reveal large anomalies near the center of the area. Cores have brought up glass fragments, substantiating the volcanic action in the area. — HRC

Sproll, W. P. *See* Dietz, R. S. 06783

00045 **Squier, L. Radley.** Load transfer in earth and rockfill dams: Am. Soc. Civil Engineers Proc., v. 96, paper 7004, Jour. Soil Mechanics and Found. Div., no. SM 1, p. 213-233, illus., tables, 1970.

The history, development, and present state of the problem of load transfer in earth and rockfill dams are reviewed, and occurrences and effects of load transfer are discussed in general. Settlements and vertical strains, upstream-downstream horizontal movements, longitudinal movements and strains, and porewater pressures on El Infiernillo Dam, and settlements and vertical strains, and stress concentration at abutment for Netzahualcoyotl Dam, both in Mexico, are described, as well as the instrumentation used to measure them. — ESL

07034 **Srinilta, Sam-arng; Nielsen, D. R.; Kirkham, Don.** Steady flow of water through a two-layer soil: Water Resources Research, v. 5, no. 5, p. 1053-1063, illus., table, 1969.

Water moving steadily through an isothermal two-layer soil is analyzed using Darcy's equation for unsaturated flow. Soil water pressure distributions were measured at 5-cm depth intervals. Unsaturated hydraulic conductivity was measured for sorption and desorption for soils used in the two-layer columns. Values of hydraulic conductivity were used to predict measured soil water pressure distributions and steady state fluxes. Agreement between predicted and measured profiles is close. The necessity of distinguishing between sorption and desorption, of obtaining a uniform soil bulk density distribution within each soil layer, and of ascertaining the hydraulic conductivity as a function of soil water pressure is discussed in relation to the predicted soil water pressure distribution and flux values. — *from* Authors' abstract

00052 **Srivastava, Lakshman S.** Stability of rock slopes, a three-dimensional study — Discussion [of paper 6363 by P. Londe, G. Vigier, and R. Vormeringer, 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM 1, p. 327-329, 1970.

Srivastava finds paper 6363 (ibid., v. 95, no. SM 1, p. 235-262, 1969), of great interest to study of rock slopes. Height and gradient of the slope depend on strength of the rock mass, pattern of the discontinuity surface, and rate of erosion, or excavation. The importance of discontinuities to analysis of mountain slope stability is discussed. Where discontinuities divide the rock mass into blocks, analysis is reduced to evaluation of stability of the blocks. — ESL

Stanley, R. S. *See* Chamberlain, E. W. 00025

Stearns, Harold T. *See* Lum, Daniel. 00033

06871 **Steidtmann, James R.** Technique for the recovery of heavy liquid separates after centrifugation: Wyoming Univ. Contr. Geology, v. 8, no. 1, p. 19, 1969.

Of various methods of removing light and heavy minerals separately from centrifuge tubes, four are not entirely satisfactory because of contamination, need for digital dexterity and additional washing, with loss of heavy liquid. Fessenden (1959) attempted to freeze and saw off a lucite tube, but it dissolved in the acetone and the grains adhered to its sticky surface. The use of "Nalgene" tubes overcomes this difficulty, so that the freeze and saw technique described here provides an effective method for recovering heavy liquid separates, with the following advantages: it is fast and simple, it prevents mixing of separates, and very little liquid is lost. — GDC

Stenning, Michael. *See* Weiss, Benjamin. 00011

Stephens, Michael. *See* Johnson, J. G. 06430

06480 **Stevens, N. B. H.** Results of the oil source rock analysis of surface samples from West Greenland, App. *in* Oil and gas prospects in the Cretaceous-Tertiary basin of West Greenland: Grönlands Geol. Undersögelse Rap. 22, p. 53-59, table, 1969.

This microchemical analysis of 23 surface rock samples was undertaken to determine the presence of source rocks of petroleum and natural gas, and to distinguish them from other types of bituminous rocks. Moisture and carbonate and nitrogen content were determined. An integrated source-rock and geological study is shown to be necessary. Interpretation of the analysis shows that true source rocks are present. A high sulfur content presents a complication as it accounts for destruction of a large part of the hydrocarbons. — ESL

Stevens, R. D. *See* Wanless, R. K. 06964

06683 **Stewart, David P.; MacClintock, Paul.** The surficial geology and Pleistocene history of Vermont: Vermont Geol. Survey Bull. 31, 251 p., illus., 1969.

This report (including material from Bull. 19) complements "Surficial geologic map of Vermont" scheduled for publication. Described are: basal and ablation tills; glaciofluvial deposits in kames, eskers and valley trains; lacustrine and marine sediments. Type of erosion is related to rock character and fabric, topography, site, and ice-contact features. Identification and correlation of drift sheets are complicated by effects of mountain terrane, complex bedrock, and multiple glaciation. The Pleistocene sequence in Vermont includes pre-Bennington,, Bennington and Shelburne glacial stades, Lake Hitchcock interstade, Burlington stade and high-level lakes, Lake Vermont stages, erosion intervals, the Champlain Sea interval, and postglacial tilting of lake and sea shorelines. Correlation is made with the St. Lawrence Lowland, southeastern Quebec, and other areas in New England. — GDC

06663 **Stewart, Keith J.** The Atlantic Provinces — A chronicle of mineral development [with French abs.]: Canada Dept. Energy, Mines and Resources Mineral Resources Br. Mineral Inf. Bull. MR 96, 41 p., illus., tables, revised 1969; originally published 1968.

The original paper which appeared in Canadian Geog. Jour., v. 77, no. 6, p. 178-195, 1968, is an account of the principal mineral resource developments in Newfoundland and Labrador, Nova Scotia, New Brunswick, and Prince Edward Island from earliest time to the present. Mineral production is reviewed by mineral sectors and mineral commodities; comparisons on both regional and national bases are made. — MCM

Stipp, J. J. *See* Farquharson, R. B. 06691

07037 **Stitt, James H.** Late Cambrian and earliest Ordovician trilobite faunas, western Arbuckle Mountains, Murray County, Oklahoma, *in* Regional geology of the Arbuckle Mountains, Oklahoma: Oklahoma Geol. Survey Guidebook 17, p. 29-35, illus., 1969.

Eighty species of trilobites from the Honey Creek Limestone and the lower part of the Arbuckle Group are discussed. A sharp change within the Franconian Stage oc-

curs between the *Elvinia* and *Conaspis* zones. The overlying Trempealeauan Stage is in the *Saukia* zone. Trilobites show that the Cambrian-Ordovician contact occurs within the Signal Mountain Limestone. This boundary is also marked by an abrupt faunal change where none of the Cambrian trilobite species, genera, or families survive into the Ordovician; this is at the top of the Conaspid biomere. — HRC

06390 **Stoddart, D. R.** Post-hurricane changes on the British Honduras reefs and cays — Re-survey of 1965: Atoll Research Bull. 131, 25 p., illus., 1969.

On October 30-31, 1961, Hurricane Hattie crossed the coastal coral reef area, shortly after an extensive survey of the geomorphology of the reefs. Early in 1962, the reef area was resurveyed as the basis of a detailed report on the immediate effects of catastrophic storms on coral reefs. In order to study long-range effects, another resurvey was made in 1965, and post-hurricane geomorphic and vegetative changes on the individual islands were documented. No general conclusions can be drawn yet on the long-term significance; resurveys must continue until equilibrium conditions are again established. Total destruction of living corals and absence of regeneration extended for 15 mi north and 12 mi south of the storm track. The recovery rate seems slow and it is not possible to predict how long reef generation may take. — ESL

06412 **Stoiber, R. E.; Rose, W. I., Jr.** Recent volcanic and fumarolic activity at Santiaguito Volcano, Guatemala: Bull. Volcanol., v. 33, no. 2, p. 475-502, illus., tables, 1969.

Santiaguito has recently exhibited renewed domal growth, as much as 50 m vertically in the first 12 months of growth. Synchronous with this activity, near the other end of the complex 1.3 km distant, there are pyroclastic eruptions. Ninety percent of the extensive hot fumarolic emission is concentrated near the active pyroclastic vent, although numerous other fumaroles are found including a group of particularly hot vents associated with the current dome of extrusion. Description and tabulation of chemical and mineralogical characteristics of sublimates and condensed gas from fumaroles at eight localities on the mountain illustrate the essential similarity and also the minor differences. The differences are in many instances related to volume of gas, amount of rainwater dilution, and amount of oxidation of the gases along their path. — *from* Authors' abstract

06585 **Storey, Taras P.** Evaporite basins show structural history: Oilweek, v. 20, no. 41, p. 7, 10, illus., 1969.

The author notes that there are three extensive subsurface Devonian evaporite basins found in Alberta. Popular explanations for thickness variations of the wedge-shaped profiles fail to account for sometimes contradictory geological evidence. Walther's law of correlations of facies indicates basin profiles are eroded structural remnants of originally much vaster areas of evaporite deposition. It is reported that older beds of the basinal cycle have a wider geographic distribution than the younger. This attests to structural uplift of this cycle after deposition of the evaporites; erosion occurred after uplift. Thus development of regional unconformity and subsequent transgression [are] consistent with Walther's law. — Editor's abstract

06675 **Stout, Larry N.** (compiler). Index to Missouri areal geologic maps, 1890-1969 (including unpublished maps on file at the Missouri Geological Survey): Missouri Geol. Survey and Water Resources Inf. Circ. 22, 67 p., illus., 1969.

Listed maps are in three classes: geologic, reconnaissance geologic, and outcrop. The following data are given for each map: author, date of completion or publication, map class, approximate area covered, type of base, scale, and containing publication (if any). The area of the state is divided into 17 index regions and a separate index map and list of maps are devoted to each of these regions. — MCM

06435 **Straka, Joseph J., 2d; Semken, Holmes A., Jr.** A dinichthyid in Middle Devonian of Iowa: Jour. Paleontology, v. 43, no. 6, p. 1423-1428, illus., tables, 1969.

An inferognathal of a large arthrodire was discovered in rip-rock of the Coralville Dam, Johnson County, Iowa. Matrix associated with the inferognathal compares

favorably with lithology of the Rapid Member of the Cedar Valley Formation exposed in nearby Vogel Quarry, the source of all rip-rock for the dam. Conodonts from the matrix confirm an age between upper Givetian and lower Frasnian. Statistical comparisons of the Vogel specimen indicate that: (1) it is specifically distinct from other known specimens; (2) dinichthyans may be divided into two groups, the larger forms referable in part to *Dinichthys* and the smaller in part to *Dunkleosteus*; (3) inferognathal ratios may not be specifically diagnostic; (4) all specimens studied represent a closely related phyletic group. — *from* Authors' abstract

06897 **Strimple, Harrell L.; Leverson, Calvin O.** Catalogue of type specimens of the Belanski collection: Bulls. Am. Paleontology, v. 56, no. 251, p. 259-271, 1969.

This study lists all specimens of the Belanski collections which have been described or published and are in the Repository, Department of Geology, University of Iowa, Iowa City. Many species that have remained in the literature as 'zonule' designations, but in fact are *nomina nuda*, are clarified. Most previously published information did not give clear locality data and an effort is made to provide as precise data as available. The species listed include 1 edrioasteroid, 8 crinoids, 1 cystoid, 5 echinoids, 14 corals, 49 brachiopods, 1 pelecypod, and 1 sponge. — MCM

06672 **Stroud, Raymond B.; Arndt, Robert H.; Fulkerson, Frank B.; Diamond, W. G.** Mineral resources and industries of Arkansas: U.S. Bur. Mines Bull. 645, 418 p., illus., tables, 1969.

Items discussed include engineering, geological and economic features; mineral reserves and resources, uses and markets, and the current status and future potential of mineral commodities available in Arkansas; demography; mineral industry organizations; taxation; land ownership, availability to mineral entry, and mining laws and regulations; transportation; sources and distribution of natural gas and electric power, and county reports. A 357-item bibliography and a list of mineral producers are appended. — MCM

06915 **Studier, Martin.** Origin of organic matter in meteorites, *in* Extra-terrestrial matter (C. A. Randall, Jr., editor): DeKalb, Ill., Northern Illinois Univ. Press, p. 25-52, illus., tables; discussion, p. 53-56, 1969.

A time-of-flight mass spectrometer combined with a gas chromatographic capillary column has been developed. Tests and calibrations with known materials show the gain is three hundred times greater than conventional systems, with a sensitivity of 100 atoms/cc. Results of analyses of organic matter in meteorites suggest that it is not necessary to assume a biogenic origin. New evidence indicates that the Miller-Urey process alone is inadequate to explain the character of the organic matter in meteorites. A remarkable similarity was found between the distribution of hydrocarbons from a synthetic sample and that isolated from a shale believed to be biogenic. The biologically important bases found in DNA and RNA have been produced by heating mixtures of CO, NH_3, and H_2. — Author's abstract

Stuiver, Minze. *See* Denton, George H. 06553

06701 **Stuiver, Minze; Borns, Harold W., Jr.; Denton, George H.** Age of a widespread layer of volcanic ash in the southwestern Yukon Territory, *in* Icefield Ranges Research Project scientific results, V. 1 (V. C. Bushnell and R. H. Ragle, editors): New York, Am.Geog.Soc., and Montreal, Quebec, Arctic Inst. North America, p. 219-220, 1969.

This paper was published originally in Arctic, v. 17, no. 4, p. 259-261, 1964. A widespread layer of volcanic ash in southwestern Yukon in lacustrine sediments and in peat and loess deposits of Little Ice Age, affords a valuable marker horizon for correlating these deposits. In 1962 Fernald reported radiocarbon dates for the ash fall at around 1636 ± 70 yr B.P. in the Tanana River valley, Alaska. Samples from southwestern Yukon gave C-14 dates of 1460 ± 70 yr B.P. and 1390 ± 70 yr B.P., indicating time of the ash fall was around 1425 ± 50 yr ago. Difference from average of Fernald suggests the possibility of two eruptions from the same source separated by

about 200 years, with older fan extending northwards. Near the southeast shore of Kluane Lake, ash occurs near the base of a 4-ft thick loess deposit; a tree buried in growth position above the ash was dated at 870 yr B.P., a minimum age for the ash. — MCM

07009 **Stumm, Erwin C.** Revision of R. P. Whitfield's types of rugose and tabulate corals in the Museum of Paleontology, University of California, and in the United States National Museum: Bulls. Am. Paleontology, v. 56, no. 250, p. 235-254, illus., 1969.

Thirteen species of Paleozoic corals were described by R. P. Whitfield between 1878 and 1903. Eleven of these are revised and all but one placed in other genera. Three new species, *Amplexizaphrentis ohioensis*, *Acanthohalysites wisconsinensis*, and *Cystihalysites microporus* are proposed and one new genus, *Syringocolumna infundibula* (Whitfield) is proposed. — Author's abstract

Sullivan, S. *See* Senftle, F. E. 07002

Surdam, Ronald C. *See* Goodwin, Jonathan H. 06709

06446 **Sutherland, J. K.; Boorman, R. S.** A new occurrence of roquesite at Mount Pleasant, New Brunswick: Am. Mineralogist, v. 54, nos. 7-8, p. 1202-1203, table, 1969.

Roquesite ($CuInS_2$) at the Mount Pleasant tin occurrence has small amounts of iron and zinc. — Authors' abstract

Sutter, J. *See* Burchfiel, B. C. 00028

00029 **Swe, Win; Dickinson, William R.** Sedimentation and thrusting of late Mesozoic rocks in the Coast Ranges near Clear Lake, California: Geol. Soc. America Bull., v. 81, no. 1, p. 165-187, illus., tables, geol. map, 1970.

Together with overthrust lower Tertiary beds, approximately 35,000 feet of clastic sedimentary strata of the Great Valley sequence, ranging in age from Late Jurassic to Late Cretaceous, form a thrust complex that rests structurally upon the Franciscan assemblage of late Mesozoic age. The complex contains at least three thrust plates and is overlain unconformably by late Cenozoic strata. Regional thrusting in the Northern Coast Ranges was probably complete by Oligocene time. The thrusts and thrust complex were later folded and cut by normal and reverse faults. — AG

06411 **Swinzow, G. K.** Certain aspects of engineering geology in permafrost: Eng. Geology, v. 3, no. 3, p. 177-215, illus., tables, 1969.

Permafrost distribution reaches one-fifth of the dry land surface of the world; its occurrence is complex and connected with many phenomena not found elsewhere. Patterned ground, ice wedges, pingoes and icings are described in general terms. The mechanical properties of soil improve drastically with freezing; strength of frozen ground, and its rheology are discussed. Foundation construction, roads, highways and airfields could not be successful without the engineering geologist. Excavation tunneling and mining are different in permafrost than elsewhere; thermal regime of artificial subsurface openings may be regulated inexpensively. Freezing ground by artificial means has colossal advantages and is widely used. In review of principal topics, mechanisms, forces and energies are emphasized; pertinent literature is quoted. — *from* Author's summary

Sykes, Lynn R. *See* Molnar, Peter. 06983

Szabo, M. W. *See* LaMoreaux, P. E. 06649

06881 **Tabor, L. L.** Field Trip — Geology of the Stanford Linear Accelerator Site, *in* 1969 field trips — Assoc. Eng. Geologists, Natl. Mtg., San Francisco, Calif., 1969: [Berkeley, Calif.] Assoc. Eng. Geologists, p. C18-C25, illus., 1969.

This guide describes the general geology, engineering geology, ground water conditions, ground movement and seismic studies, and seismic design factors connected with the Stanford Linear Accelerator site. — DBV

Takagi, Robert S. *See* Berry, William B. N. 06846

Takahashi, Taro. *See* Ahrens, Thomas J. 00006

Talent, John A. *See* Boucot, Arthur J. 06911

Talwani, M. *See* Ewing, M. 06748

06526 **Tank, Ronald.** Clay mineral composition of the Tipton Shale Member of the Green River Formation (Eocene) of Wyoming: Jour. Sed. Petrology, v. 39, no. 4, p. 1593-1595, illus., 1969.

X-ray analyses indicate that illite, montmorillonite, and chlorite are abundant in the less-than-2μ fraction of the Tipton Shale Member of the lacustrine Green River Formation (Eocene). Material amorphous to X-rays and mixed-layer structures are present in subordinate amounts. These minerals have been known to occur in rocks of lacustrine origin, but this investigation shows a general correlation between lithology and clay mineral suite. An illite suite is restricted to the argillaceous and analcimic tuffs near the top of the member. A chlorite-illite suite is found only in the coarser clastics developed in the middle of the member, and a montmorillonite-illite suite is restricted to the montmorillonitic tuffs and oil shales of the base of the member. Source rock and diagenetic alteration account for the distributional pattern. — Author's abstract

06382 **Tapley, Sandra.** Foraminiferal analysis of the Miramichi Estuary: Maritime Sediments, v. 5, no. 1, p. 30-39, illus., 1969.

The Miramichi Estuary drains eastern and central New Brunswick and empties into the Gulf of St. Lawrence. A string of barrier islands prevents much intermingling of bay and ocean water. Mud flats cover the inner and southern bay bottom, and sand extends in from the Gulf along the northern coast. The effects of environmental parameters on special assemblages of foraminifera are discussed; assemblages of benthic foraminifera have been assigned to specific biofacies, river and bay fauna. Trends between the observed distribution and abundance, and the physical-chemical environmental parameters are noted. — ESL

Tarshansky, I. W. *See* Aisiks, E. G. 06486

06902 **Taylor, F. C.** (compiler). Geology, Annapolis-St. Marys Bay area (east half, and west half), Nova Scotia: Canada Geol. Survey Map 1225A (also in Mem. 358), 2 sheets, scale 1:126,720, 1969.

06966 **Taylor, G. J.; Heymann, D.** Shock, reheating, and the gas retention ages of chondrites: Earth and Planetary Sci. Letters, v. 7, no. 2, p. 151-161, illus., tables, 1969.

In order to investigate shock and reheating effects in ordinary chondrites, 71 bronzite, 26 hypersthene, and 6 amphoterite chondrites were examined by X-ray diffraction and 39 bronzite and 19 hypersthene chondrites were studied metallographically. In addition, the inert gas contents of 11 bronzite and 4 hypersthene chondrites were measured mass spectrometrically. We found that virtually all chondrites with short gas retention ages (<2 b.y.) are substantially shocked and reheated, whereas those with ages >3 b.y. are not reheated to any appreciable extent, although they may be strongly shocked. We have concluded that the reheating observed in chondrites is generally related to shock and that these shock-induced reheating events took place before chondrites were ejected from their parent objects. — Authors' abstract

06569 **Taylor, Hugh P., Jr.; Epstein, Samuel.** Correlations between O-18/O-16 ratios and chemical compositions of tektites: Jour. Geophys. Research, v. 74, no. 27, p. 6834-6844, illus., tables, 1969.

The limits of oxygen isotope variation in tektites have been determined by analyzing 33 tektites covering the widest spectrum of chemical compositions. Results show a systematic increase in O-18 with decreasing SiO_2 content in all groups. These systematic correlations must arise either by vapor fractionation of tektite material during impact melting or by mixing of a SiO_2-rich igneous component and a low-SiO_2 component formed at a much lower temperature, the mixture possibly occurring during weathering at the Earth's surface or during hydrothermal alteration of silicic igneous rocks either on the Earth or on the Moon. — GV

Taylor, Robert L. *See* Goodman, Richard E. 00056

Tenbrink, Norman W. *See* Bockheim, James G. 06385

07036 **Thiers, G. R.; Seed, H. B.** Strength and stress-strain characteristics of clays subjected to seismic loading conditions, *in* Vibration effects of earthquakes on soils and foundations — ASTM, 71st Ann. Mtg., San Francisco, 1968, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 450, p. 3-56, illus., table, 1969.

Simple-shear pulsating-load tests on three soils indicate that while the decrease in dynamic strength with the number of cycles increases with the failure strain observed in static strength tests, a plot of the product of failure strain × dynamic strength against the number of cycles is about the same regardless of the failure strain. Cyclic-loading triaxial compression tests show, after 200 cycles of loading, that the peak cyclic strain is less than one half the static failure strain, the strength being 80 percent of the original. A three-parameter model (2 moduli and a yield strain) show the decrease in the ratio of dynamic modulus/original static modulus with the ratio of cyclic-strain failure strain is about the same for all three soils for a given number of cycles. The static modulus of each soil tested was greatly reduced by cyclic loading. — *from* Authors' abstract

06402 **Thomas, A. N.** Permafrost, the major challenge: Oilweek, v. 20, no. 37, p. 40, 42, 45-46, illus., 1969.

In Alaska the base of permafrost is usually assumed to be between 900 and 1200 feet below sea level. The permafrost zone contains some layers of gravel free of ice, also lenses of almost pure ice. Permafrost is mapped as continuous, discontinuous, or sporadic zones, concentric around the North Pole. Under deep lakes, large rivers, and the main body of oceans, permafrost is thinning. In tundra areas there is alternate freezing and thawing at the surface. Problems posed by permafrost affecting oil exploration are: movement over the surface, seismic interpretation, drilling, production of hot oil, building and pipeline construction, and water supply and sewage disposal. — ESL

Thompson, Margaret D. *See* Burger, H. Robert. 06859

Thompson, R. R. *See* Benedict, L. G. 06842

Thorpe, A. N. *See* Senftle, F. E. 07002

Threadgold, I. M. *See* Blount, Alice M. 06988

06399 **Thurston, William.** International Geological Congress, growth and change: Geotimes, v. 14, no. 10, p. 15-18, tables, 1969.

The first session, held in 1878 in Paris, was described in the February 1968 issue of this magazine. This article is a sequel, based on proceedings volumes published from 1879 to 1964, giving an outline of the organization's growth. — Author's abstract

Tocher, Don. *See* Romig, P. R. 06982

Tokonami, Masayasu. *See* Morimoto, Nobuo. 06452

06900 **Tolman, Carl F.; Robertson, Forbes.** Exposed Precambrian rocks in southeast Missouri (Contribution to Precambrian geology No. 1): Missouri Geol. Survey and Water Resources Rept. Inv. 44, 68 p., illus., geol. map, 1969.

Precambrian igneous rocks, exposed in the St. Francois Mts., include a thick series of felsitic flows and welded tuffs extruded on older basement rocks, and intruded by a granite batholith. Pre-batholithic rocks are divided into two groups: the older Middlebrook and younger Van East groups, separated by tuffs in places, exposures of which indicate subaqueous deposition. The batholith, a concordant sill intruded between the two felsite groups, is composed of granites and granite porphyry. Rocks of the earlier phase of intrusion are designated as the Musco group, and those of the later phase, the Bevos group. Differentiation is indicated. Basic dikes and sills intrude both felsite and granite. It is believed that the exposed igneous rocks represent a major petrogenic epoch of short duration in the late Precambrian. — *from* Authors' abstract

06396 **Tonani, F.** Volcanic gases — A field-geochemical approach: Geol. Soc. London Proc. 1969, no. 1655, p. 116-121, 1969.

Current use of field methods has greatly increased our knowledge of volcanic gases and related materials, and investigations can be planned on the basis of factual information about the specific system; also field methods may detect features of the geochemistry which would be missed by laboratory analysis. Methods available at present are classified according to information they give in the field: first group, includes chemical determinations as well as physical measurements; the second, day-by-day determinations; and the third, determinations carried out in the laboratory. Implements include: a field kit for gas analysis using detector tubes including one for acid gases, and a specially designed pump and sampling tubes; portable analyzers; and field laboratories for water analysis and determination of dissolved gases. Geothermal areas, studied in a more systematic way, appear to be fed by meteoric water with thermal anomalies due to magmatic processes. — ESL

00049 **Torrance, J. Kenneth.** Causes of clay sensitivity — Discussion [of paper 6568, by J. K. Mitchell and W. N. Houston, 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM 1, p. 360-361, 1970.

Mitchell and Houston's insight into relative importance of the various possible causes of clay sensitivity makes this (ibid., v. 95, no. SM 3, p. 845-871, 1969) a valuable review paper. Additional information based on recent work at the Norwegian Geotechnical Institute is added, revealing some hitherto unknown aspects of the leaching process, including a possible new index of weathering and an explanation of sensitivity of illitic-chloritic quick clays. — ESL

06421 **Trow, W. A.; Morton, J. D.** Laterite soils at Guardarraya, La Republica Dominicana, their development, composition and engineering properties, *in* Internat. Conf. Soil Mechanics and Found. Eng., 7th, Mexico, 1969, Specialty Sess. Eng. Properties of Lateritic Soils, Proc., V. 1: Bangkok, Thailand, Asian Inst. Technology, p. 75-84, illus., tables, 1969.

Ferruginous laterites have been developed by tropical weathering of ultramafic peridotite bedrock at a project site in Republica Dominicana. The soils exhibit several unusual engineering properties, reflecting the high iron content and almost complete absence of normal clay-forming minerals. A high content of clay size particles as determined by general opaqueness in X-ray diffraction tests contrasts with low compressibility and high shear strength c and ϕ values. Difficulty is experienced in interpreting such standard laboratory tests as plasticity, grain size and compaction. Some comparisons with laterite soils developed from basaltic or other basic rock types in other areas of the world are made. — Authors' abstract

06389 **Tucker, M. M. Riddler.** Preliminary study of some Wyoming Paleozoic carbonates: Earth Sci. Bull., v. 2, no. 3, p. 21-25, reprinted in part, 1969; originally published 1968.

The paper was originally published in Iowa Acad. Sci. Proc. 1966, v. 73, p. 234-252, 1968. *See* Abstracts of North American Geology for February 1969. — MCM

Tucker, W. E. *See* LaMoreaux, P. E. 06649

06927 **Udintsev, G. B.** Glubokovodnoye bureniye v okeane: Priroda, no. 8, p. 32-39, illus., 1969.

This article describes results obtained so far by the JOIDES Deep Drilling Program of the United States. The very preliminary results so far published on the expeditions of the "Glomar Challenger" give some idea of the vast scientific significance of the results obtained, demonstrate the technical feasibility of drilling in the deep ocean, and open new perspectives for marine geology. — DBV

06933 **U.S. Geological Survey.** Geological Survey research 1969, Chap. A: U.S. Geol. Survey Prof. Paper 650-A, p. A1-A425, illus., 1969.

This summary of recent significant scientific and economic results of 1969 research includes the following: resources investigations; geologic and hydrologic principles, processes, and techniques; geology and hydrology applied to engineering and the public welfare; astrogeology; remote sensing and advanced techniques; geologic and hydrologic investigations in other countries; topographic surveys and mapping; computer technology; publications program; cooperators and other financial contributors; U.S. Geological Survey offices; investigations in progress in the Conservation, Geologic, and Water Resources Divisions; contents of Geological Survey research 1969, Chapters B, C, and D; publications by Survey authors in fiscal year 1969; and indexes — publications, subject, and investigator. — MCM

06926 **Vall, Victor.** Measuring earth strains by laser: Sci. American, v. 221, no. 6, p. 88-95, illus., 1969.

Geophysical laser strain meters, essentially large interferometers, are theoretically capable of measuring strain amplitudes with an accuracy of a few parts in 10^{15}. Several of these instruments already operate; one is 1020 m long and is accurate to one part in 10^{12} for short periods of time. Laser strain meters should be useful in attempts to predict earthquakes; monitoring of the strain state of manmade structures such as dams, large buildings and mines; investigating sea-floor spreading by attempting to measure the rate of rifting across the Mid-Atlantic Ridge in Iceland; and perhaps determining if the gravitational waves predicted by the general theory of relativity actually exist. — DWR

06969 **Vance, Joseph A.** On synneusis: Contr. Mineralogy and Petrology, v. 24, no. 1, p. 7-29, illus., 1969.

Synneusis is the process of the drifting together and mutual attachment of crystals suspended in a melt; the process is episodic, is most characteristic of the early stages of consolidation, and appears to be related to magmatic turbulence. Synneusis structures have generally been overlooked or misinterpreted as epitaxial intergrowths, primary twins, irregular growth forms, or the random union of crystals. This process is responsible for three major features of the magmatic fabric: (1) the small scale segregation of minerals, (2) the systematic mutual orientation of adjacent crystals in synneusis relation, and (3) the morphology of their common boundary. Because synneusis structures are restricted to igneous rocks and are widespread and easily recognized, they provide a definitive and ready criterion of magmatic origin. — *from* Authors' abstract

VanDerKamp, G. S. *See* Carr, P. A. 06416

vanDonk, Jan. *See* Broecker, Wallace S. 06742

VanEck, Orville J. *See* Hase, D. H. 06930

06697 **vanEverdingen, R. O.** Degree of saturation with respect to $CaCO_3$, $CaMg(CO_3)_2$, and $CaSO_4$ for some thermal and mineral springs in the Southern Rocky Mountains, Alberta and British Columbia: Canadian Jour. Earth Sci., v. 6, no. 6, p. 1421-1430, illus., tables, 1969.

Water from Fairmont Hot Springs and Banff Hot Springs, and from thermal springs in British Columbia, on Lussier River, Ram Creek, and near Fording Mountain, are supersaturated with respect to $CaCO_3$ and, to a lesser extent, with respect to $CaMg(CO_3)_2$. In the case of hot springs this is caused by the rise in pH that accompanies loss of excess CO_2 and, to a lesser degree, by evaporation; cooling of the water tends to lower the degree of saturation somewhat. At cold springs, increase in water temperature after discharge increases the degree of saturation. Only near-saturation with respect to $CaSO_4$ is indicated for Miette Hot Springs, Fairmont Hot Springs and Fording Mountain Springs; precipitation of $CaSO_4$ may occur here owing to evaporation of part of the water; the effect of temperature on the degree of saturation is small. —*from* Author's abstract

06686 **VanLandingham, Sam L.** Catalogue of the fossil and Recent genera and species of diatoms and their synonyms (a revision of F. W. Mills' "An index to the genera and species of the Diatomaceae and their synonyms," [1933-35]) — Pt. 3, *Coscinophaena* through *Fibula*: Lehre, Germany, Verlag von J. Cramer, p. 1087-1756, 1969.

This volume is the third in the alphabetical cataloging, as completely as possible, of taxonomic entries of diatoms through 1964 (ibid., Pt. 1, 1967; Pt. 2, 1968; Pt. 2 is cited in Abstracts of North American Geology, Dec. 1969). The catalog contains: revised entries from F. W. Mills' index, covering approximately the years 1786 through 1934; many entries prior to 1934 omitted by Mills; all entries introduced from 1934 through 1964; and bibliographic reference lists appropriate to each part. The introduction to Pt. 3 contains a percentage frequency diagram of entries of specific and infraspecific taxa according to nationality of authors, and comments on some reviews of Pt. 1 of the catalog. — VMJ

06506 **VanVoast, Wayne A.** Profiles of regional ground-water flow in glacial deposits in Minnesota, based upon existing well data, *in* Engineering geology and soils engineering symposium, 7th Ann., Moscow, Idaho, 1969, Proc.: Boise, Idaho, Idaho Dept. Highways, p. 84-100, illus., 1969.

Regional ground-water flow patterns in glacial deposits can be determined by contouring hydraulic potential on vertical sections, using well bottoms as control points; the values of hydraulic potential are water-level altitudes. Ground-water flow systems in three watersheds in southwestern Minnesota illustrate the effects of topography and thickness and extent of hydrogeologic units on flow patterns. Understanding of regional ground water flow systems can help avoid some problems of surface water dependability, ground-water pollution, and highway construction. — DBV

Vardy, Peter. *See* McCulloch, D. S. 06987

00051 **Viggiani, Carlo; Davis, Edward H.; Poulos, Harry G.** An analysis of consolidation theories — Discussion [of paper 6370, by R. L. Schiffman, A. T-F. Chen, and J. C. Jordan, 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM 1, p. 331-336, illus., 1970.

Viggiani believes the pseudo three-dimensional Terzaghi-Rendulic theory used by Schiffman, Chen, and Jordan (ibid., v. 95, no. SM 1, p. 285-312, 1969) should be modified to predict the excess pore pressure-time relation. Davis and Poulos cite evidence that the approximate diffusion theory is capable of predicting consolidation behavior under two- and three-dimensional strain conditions with an accuracy sufficient for engineering purposes and has the advantage of being easily employed to solve complicated problems. — ESL

00071 **Vittori A., O.** Earth accretion in "black spherules": Jour. Geophys. Research, v. 75, no. 2, p. 371-374, illus., table, 1970.

Airborne ferromagnetic particles were collected at 2,000 m altitude and analyzed under an optical microscope to determine the Earth accretion rate in "black spherules". Concentrations and ratios of Fe, Ni, and Co were determined in the samples and compared with data from other stations. The results suggest that most ferromagnetic fallout is independent of sampling locality and may therefore be of extraterrestrial

origin. An improved method for determining particle counts is presented. — Author's abstract

vonHuene, Roland. *See* Scholl, David W. 00065

06578 **vonHuene, Roland.** Geologic structure between the Murray fracture zone and the Transverse Ranges: Marine Geology, v. 7, no. 6, p. 475-499, illus., 1969.

A geophysical study shows no structural continuity between the Murray fracture zone in the eastern Pacific Ocean and the Transverse Ranges of California. Basement morphology of the Murray zone dies out where the magnetic and bathymetric expression die, and the east-west Transverse Ranges change direction to parallel the coast. The lack of continuity suggests an independent development of the Transverse Ranges since at least mid-Tertiary time along an older structural trend continuous with the Murray zone. Possibly a fundamental lineament in the crust, an extension of the Murray, inactive since at least mid-Tertiary time, provided a convenient trend for development of the Transverse Ranges in response to deformation along the San Andreas Fault system. — *from* Author's summary

Vormeringer, Raymond. *See* Londe, Pierre. 00044

Vostokova, E. A. *See* Ogilvie, N. A. 06420

06428 **Wagner, Richard E.; Kisvarsanyi, Eva B.** Lapilli tuffs and associated pyroclastic sediments in the Upper Cambrian strata along Dent Branch, Washington County, Missouri: Missouri Geol. Survey and Water Resources Rept. Inv. 43, 80 p., illus., geol. maps, 1969.

Late Cambrian pyroclastic rocks exposed along the northwest flank of the St. Francois Mtn. region, in the lower third of the Bonneterre Formation, represent a previously unknown center of explosive activity. The pyroclastics have a maximum known thickness of 80 feet and consist of lapilli tuffs, and tuffaceous sandstones and siltstones. To the east and south of the outcrops, the underlying Bonneterre dolomite and Precambrian felsite are exposed; to the west and north the pyroclastics are overlain by Bonneterre dolomite. Lapilli tuffs were deposited in a marine environment, and partially reworked. The occurrence may indicate a line of structural instability in the underlying Precambrian. Magma triggering the explosions is assumed to have been basic to ultrabasic. The lapilli tuffs resemble those associated with alkalic ultrabasic complexes in tectonically stable continental areas. — *from* Authors' abstract

00031 **Wagner, W. Philip.** Ice movement and shoreline modification, Lake Champlain, Vermont: Geol. Soc. America Bull., v. 81, no. 1, p. 117-126, illus., 1970.

Distinctive ice movements on Shelbourne Bay were caused by lake level rises, ice and snow ablation, and ice temperature fluctuations during complete ice cover, and by wind action during ice breakup. Shoreline modification is very limited on Lake Champlain due to continuous snow cover, the development of numerous pressure ridges, the relatively short period of partial open water, and the weakened condition of the ice during ice breakup. Factors controlling ice-sediment interactions on Shelbourne Bay are particle size, steepness of bottom slope, and shoreline configuration. — *from* Author's abstract

06564 **Wagner, W. Philip.** Snow facies and stratigraphy on the Kaskawulsh Glacier, *in* Icefield Ranges Research Project scientific results, V. 1 (V. C. Bushnell and R. H. Ragle, editors): New York, Am. Geog. Soc., and Montreal, Quebec, Arctic Inst. North America, p. 55-62, illus., tables, 1969.

When measurements were made on Kaskawulsh Glacier during the 1963 melt season, ablation facies extended from the terminus at 810 m to the firn line at 1990 m. Temperature, hardness, and stratigraphic relations located the saturation line between 2330 m and 2420 m. Significant melt occurred everywhere on the glacier, hence the dry snow facies was precluded. Variation of density with altitude was found to be gradational across the saturation line, suggesting only the wetted facies

occurred everywhere in the accumulation zone. Because density is not considered a useful parameter for separating wetted and percolation facies on this glacier, density data are rejected as a primary parameter. On the basis of temperature, hardness, and stratigraphy, both wetted and percolation facies were subpolar, indicating the glacier was subpolar in 1963. — *from* Author's abstract

06996 **Wagner, W. Philip.** Description and evolution of snow and ice features and snow surface forms on the Kaskawulsh Glacier, *in* Icefield Ranges Research Project scientific results, V. 1 (V. C. Bushnell and R. H. Ragle, editors): New York, Am. Geog. Soc., and Montreal, Quebec, Arctic Inst. North America, p. 51-53, 1969.

Investigations of numerous snow pits on Kaskawulsh Glacier suggested that the 1963 summer could be viewed in terms of a threefold, sequential development of surface and subsurface features related to snow melt: Stage 1, characterized by thin ice layers and rounded, medium-grained snow immediately underlying a nondescript snow surface; Stage 2, begun on July 1 with a pronounced warm spell, included surface depressions, ice and slush glands, 'slush columns', with lateral expansion of surface depressions and related subsurface features; by July 21, growth of surface depressions resulted in a snow surface with conspicuous mounds (distinctive for Stage 3), remnants of the inter-depression areas of Stage 2. Stages 1 and 3 began and ended when melt began in the spring and ended in the fall, respectively; dates of these stages are unknown. — Author's abstract

06939 **Waldbaum, D. R.** Some observations on preparing glass compositions on the alkali feldspar join: Am. Jour. Sci., v. 267, no. 10, p. 1249-1253, 1969.

High-purity glass of alkali feldspar composition can be prepared in a single fusion by making use of natural feldspars purified by ion-exchange as starting materials. Glass prepared by fusion of crystalline feldspars is not significantly hygroscopic under normal laboratory conditions. — Author's abstract

Wallace, Robert E. *See* McCulloch, D. S. 06987

Wallin, Charles. *See* Bowles, Frederick A. 06522

07045 **Walsh, M. H.** Fairview area, Richland County, Montana, *in* Eastern Montana symposium — Montana Geol. Soc., 20th Ann. Conf., 1969: Billings, Mont., Montana Geol. Soc., p. 129-134, illus., 1969.

The oil accumulations in the Red River Formation are basically controlled by structure, and the structures can be found with the seismograph. Early growth of the structures is important, and particular attention should be given to isopach work. The size of the fields will be small as they are a function of the small, sharp structures that normally occur in this part of the Williston basin. — *from* Author's conclusions

06964 **Wanless, R. K.; Stevens. R. D.; Loveridge, W. D.** Excess radiogenic argon in biotites: Earth and Planetary Sci. Letters, v. 7, no. 2, p. 167-168, illus., 1969.

The response of K-Ar and Rb-Sr isotopic systems to thermal events has been studied for both biotite and muscovite samples. Anomalously high radiogenic argon concentrations have been found in some biotites. — Authors' abstract

Ward, S. H. *See* Hood, Peter. 06910

06509 **Warnke, Detlef A.; Gram, Ralph.** The study of mineral-grain surfaces by interference microscopy: Jour. Sed. Petrology, v. 39, no. 4, p. 1599-1604, illus., 1969.

The microtopography of mineral-grain surfaces can readily be studied through differential-interference microscopy of grain-surface replicas in transmitted light. This method is a valuable complement to existing electron microscopic methods. — Authors' abstract

06388 **Watson, Anne.** The L-O-N-G drought: Earth Sci. Bull., v. 2, no. 3, p. 15-20, illus., 1969.

The post-glacial Altithermal period was an important factor in shaping prehistoric events in the Great Plains and Great Basin areas. The work of several writers who have contributed to our knowledge is reviewed. Some of the more important cave sites are described. Material has been found which can be dated with sufficient accuracy to support the idea of a substantial occupation of the Plains during the Altithermal. — ESL

06530 **Watson, Jerry A.; Angino, Ernest E.** Iron-rich layers in sediments from the Gulf of Mexico: Jour. Sed. Petrology, v. 39, no. 4, p. 1412-1419, illus., tables, 1969.

Thin yellow layers (0.5 to 2 cm) examined in seven cores in the west and central portions of the Gulf of Mexico are enriched in iron, manganese, cobalt, and nickel with respect to the surrounding sediments. The average enrichment is 66, 33, 51, and 28 percent, respectively. The highest correlation coefficients between single pairs of elements yield Co:Ni ($r = 0.53$), Fe:Ni (0.64), Fe:Co (0.62), and Mn:Co (0.50). The yellow, iron-rich sediments commonly occur in the Pleistocene-Holocene transition zone and in the upper Pleistocene sediments. The iron-rich zones are considered to be the result of a reduced sediment accumulation rate. Carbon-14 dates support this argument. The close association with iron-stained foraminiferal tests in the sediments suggests post-depositional scavenging. The yellow layers are most prevalent on the lower continental slope, continental rise, and Sigsbee abyssal plain. — Authors' abstract

Watson, Richard A. *See* White, William B. 00012

Weaver, Charles E. *See* Abdul-Latif, Numan. 06872

Weber, William M. *See* Bockheim, James G. 06385

Wedeking, John A. *See* Gault, Donald E. 06558

06572 **Weertman, J.** Dislocation motion on an interface with friction that is dependent on sliding velocity: Jour. Geophys. Research, v. 74, no. 27, p. 6617-6622, illus., 1969.

It is shown that smeared-out dislocations can move at a supersonic velocity across slip or fault planes if the sliding velocity across the plane is determined by a dynamic friction stress. The friction stress is assumed to decrease as the sliding velocity increases. It also is shown that smeared-out dislocations can move at the Rayleigh wave velocity if they are edge dislocations and at the traverse wave velocity if they are screw dislocations. — Author's abstract

06904 **Weertman, J.** The stress dependence of the secondary creep rate at low stresses [discussion of two papers by M. Mellor and R. Testa, 1969]: Jour. Glaciology, v. 8, no. 54, p. 494-495, 1969.

This note points out that although Mellor and Testa (ibid., no. 52, p. 131-145 and 147-152, 1969) used creep tests that ran for almost one year, the time duration of tests is many orders of magnitude too short to establish a true secondary creep rate at low stresses. Therefore, no conclusion at all can be made as to the stress dependence of secondary creep rate at low stresses. An example is cited to prove that stress dependence of creep rate can be quite different at very small creep strains from that at large creep strains. — VSN

00047 **Weggel, Harold A.** Bridge foundation behavior in Alaska earthquake — Discussion [of paper 6664 by G. S. Ross, H. B. Seed, and R. R. Migliaccio, 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM 1, p. 365-367, illus., 1970.

Ross, Seed, and Migliaccio have prepared a composite review of damages caused to bridges by the March 27, 1964, earthquake (ibid., v. 95, no. SM 4, p. 1007-1036, 1969). Weggel describes several of the failures, believes that wave action in silt deposits has characteristics similar to translatory waves in water, does not agree with Ross, et al, that inward movement of the abutments is due to a streamward movement of the banks, but believes it is due to nonsynchronism of movement on the two banks. — ESL

06545 **Weidie, A. E.; Wolleben, J. A.** Upper Jurassic stratigraphic relations near Monterrey, Nuevo León, Mexico: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 12, p. 2418-2420, illus., 1969.

In the Sierra del Fraile 30 km northwest of Monterrey, Minas Viejas Evaporites section is, in ascending order, reef limestone, shale, and limestone. From physical correlations with similar sections in nearby sierras, the lower (reef) limestone could be either a reef buildup in the basal part of the Taraises Formation (lowermost Cretaceous), or the Upper Jurassic Zuloaga Limestone conformably overlain by the Upper Jurassic La Casita Formation. Discovery of ammonites of early Kimmeridgian age in the upper limestone established the identity of rocks in the section in the Sierra del Fraile. — BHK

00011 **Weiss, Benjamin; Boettner, Edward A.; Stenning, Michael.** Determination of quartz — Evaluation of the differential thermal analysis method: Archives Environmental Health, v. 20, no. 1, p. 37-44, illus., tables, 1970.

Differential thermal analysis was evaluated for determination of quartz after comparing it with other methods. Effect of particle size on peak height was studied by preparing calibration curves for sized quartz in silicon carbide. It was found that thermal response decreases with decreasing particle size, indicating necessity for size analysis of unknown samples. Commercial talc and granite samples were analyzed for quartz after size determination and dilution with 30 percent SiC; results compare favorably to those obtained by phosphoric acid digestion. Foundry samples were similarly analyzed after preheating to combust carbonaceous material; these settled dusts were also analyzed using standard addition and internal standard techniques. X-ray diffraction analysis was used for comparison with thermal procedures and agreement was found between the X-ray and DTA results. — *from* Authors' abstract

06681 **Wells, Philip V.** Preuves paléontologiques d'une végétation tardi-pleistocène (datée par le ^{14}C) dans les régions aujourd'hui désertiques d'Amérique du Nord [translated from English by C. Vergnaud-Grazzini (with English abs.)]: Rev. Géographie Phys. et Géologie Dynam., ser. 2, v. 11, pt. 3, p. 335-340, tables, 1969.

More than 30 middens of *Neotoma* (wood rat) dung, found beneath rocky debris in the Great Basin, Mohave, Sonoran and Chihuahuan Deserts, contain abundant beautifully preserved plant remains with C-14 ages of 8,000>20,000 years. The now very arid regions of North America supported xerophilous pinyon-juniper-oak woodland as late as the close of the Wisconsin glaciation, in contrast to the present desert shrub vegetation. Woodland species now confined to the higher mountains descended 600-650 m in elevation in the Mohave and at least 800 m in the Chihuahuan Desert during the Wisconsin pluvial interval. Middens from the Baja California sector of the Sonoran Desert constitute the first Pleistocene paleoecological record from a nonorographic desert in North America. — VMJ

Wells, Terry L. *See* MacTavish, John N. 07030

Wessel, James M. *See* Hand, Bryce M. 06533

06500 **West, Lawrence J.** Rock mechanics application at projects involving underground excavations and a high cut slope [abs.], *in* Engineering geology and soils engineering symposium, 7th Ann., Moscow, Idaho, 1969, Proc.: Boise, Idaho, Idaho Dept. Highways, p. 2, 1969.

06644 **West, T. R.** Textural analysis and engineering testing of degrading, base course aggregates, *in* Engineering geology and soils engineering symposium, 7th Ann., Moscow, Idaho, 1969, Proc.: Boise, Idaho, Idaho Dept. Highways, p. 247-270, illus., tables, 1969.

A study of aggregate degradation provided the opportunity to explore the specific relationships of texture, rock structure, and degradation. The final results were obtained by comparing petrographic data and engineering test data to the degradation value. Three rock groups — carbonate rocks, phaneritic igneous and metamorphic rocks, and basaltic rocks — were analyzed separately. Results are presented in tables and cluster diagrams. — DBV

White, Brian. *See* Burger, H. Robert. 06860

White, J. L. *See* Juo, A. S. R. 06427

00012 **White, William B.; Watson, Richard A.; Pohl, E. R.; Brucker, Roger.** The central Kentucky karst: Geog. Rev., v. 60, no. 1, p. 88-115, 150, illus., 1970.

This hard region is an area of some two hundred sq mi, including a segment of doline karst, the Sinkhole plain, and a karst plateau. The plateau lies mainly within Mammoth Cave National Park and is underlain by Flint Ridge cave system and by Mammoth Cave. The plateau is ringed with a complex of vertical shafts that are an integral part of the drainage from the perched ground-water body in the protective cap rock. Development of the karst area can be interpreted in terms of the unique relation between the stratigraphic sequence of thick, bedded limestones and of clastic rocks and the location of recharge and discharge areas. Lateral flow from the Sinkhold plain beneath the protected plateau has generated a cave complex of long tubular conduits connected by shafts, shaft drains, and piracy routes. — *from* Authors' abstract

Whitman, Walter W. *See* Porter, Chris R. 06594

06477 **Whitney, Philip R.** Variations of the K/Rb ratio in migmatitic paragneisses of the northwest Adirondacks: Geochim. et Cosmochim. Acta, v. 33, no. 10, p. 1203-1211, illus., tables, 1969.

Data for the migmatitic paragneisses of the northwest Adirondacks indicate fractionation of K and Rb during metamorphism and migmatization; total rock K/Rb ratios are controlled to a significant degree by modal composition. Biotite-poor granitic veins and lenses show K/Rb ratios averaging 431 in contrast to the host gneisses which have an average K/Rb ratio of 271. Paragneisses from the zone of granulite facies metamorphism show significantly higher (mean 307) K/Rb ratios than those from the amphibolite facies (231), indicating the possibility of regional depletion in Rb relative to K under intensive metamorphic conditions. — Author's abstract

Wideman, C. J. *See* Romig, P. R. 06982

00032 **Wiebe, Robert A.** Relations of granitic and gabbroic rocks, northern Santa Lucia Range, California: Geol. Soc. America Bull., v. 81, no. 1, p. 105-116, illus., geol. map, 1970.

The plutonic rocks of the northern Santa Lucia Range are calc-alkaline and consist of hornblende gabbro, tonalite-granodiorite, and quartz monzonite of probable Cretaceous age. They were emplaced concordantly during regional folding and metamorphism at temperatures above 650° and at depths of 15-20 km. The country rocks are mainly quartzofeldspathic metasediments (Sur series) of probable Paleozoic age. The earliest major intrusives were hornblende gabbro and leucocratic quartz monzonite; the next younger plutons were tonalite-granodiorite that locally intruded the older intrusive terrane; the last major intrusives were quartz monzonite. Contacts between plutons range from sharp to gradational, and hybrid rocks occur locally. The gabbro probably was mostly solid when the quartz monzonite intruded it, but there is some evidence of some mixing of the magmas with resultant hybridization and gradational contacts. — *from* Author's abstract

Wilde, Garner L. *See* Skinner, John W. 06439

Wilhelm, Robert O. *See* McCulloch, D. S. 06987

06394 **Williams, Alwyn.** Helen Marguerite Muir-Wood (1895-1968): Geol. Soc. London Proc. 1969, no. 1655, p. 123-125, 1969.

06519 **Williams, David J. A.** Discussion of the paper "Settling convection and grain size analysis" [by P. H. Kuenen, 1968]: Jour. Sed. Petrology, v. 39, no. 4, p. 1641-1643, 1969.

Kuenen (ibid., v. 38, no. 3, p. 817-831, 1968; Abstracts of North American Geology, Feb. 1969) suggested that the effects of settling convection had been overlooked or ignored as being a secondary phenomenon in hindered settling investigations. Attention is drawn to several investigators who have discussed convection in sedimentation. Among them are Hassett and Freshwater (1959), Ponder (1925), Boycott (1920), Kinosita (1949), Nakamura (1937), and numerous others. — HRC

06462 **Williams, H. S.** Gravity and gradients of long tunnels: Am. Soc. Civil Engineers Proc., v. 95, paper 6815, Jour. Surveying and Mapping Div., no. SU1, p. 11-24, illus., tables, 1969.

Effects of disturbances in the local gravity field of the Earth on gradients of long tunnels is explored and a simple method of locating any particular geopotential horizon in a pilot shaft suggested, using Prey's formula and geopotential or relative geopotential numbers. Little difficulty with gradients of long tunnels need be anticipated from naturally occurring gravity anomalies, even as large as 500 mgals. As long as height differencing is involved, determination of shaft depths to given level surfaces remains simple. The 51-mile long Orange-Fish Tunnel in Africa's Cape Province is a practical example; the invert level of its No. 2 shaft only needs a correction of -0.15-ft relative to the inlet of the tunnel 14 miles away. Such correction will create no engineering problem in maintaining the 1 to 2,000 gradient of the tunnel or in construction of the concrete lining. — *from* ASCE abstract

Williams, James H. *See* Dean, Thomas J. 06652

Wilson, J. T. *See* Crawford, A. R. 06771

06541 **Wilson, Joseph M.** Melvin Miller Garrett (1894-1969): Am. Assoc. Petroleum Geologists Bull., v. 53, no. 12, p. 2559-2560, portrait, 1969.

06682 **Wilson, Lee.** Les relations entre les processus géomorphologiques et le climat moderne comme méthode de paléoclimatologie [translated from English by F. Arkwright (with English abs.)]: Rev. Géographie Phys. et Géologie Dynam., ser. 2, v. 11, pt. 3, p. 303-314, illus., tables, 1969.

Climate-process systems (CPS) are sets of climatic conditions under which particular suites of geomorphic processes are dominant. Six recognized systems are: glacial — glaciation, nivation; periglacial — solifluction, frost action; arid — wind, dessication; semiarid — streams, planation; humid temperate — weathering, creep, streams; selva (humid tropical) — chemical weathering, landslides, streams. Glacial, arid, humid temperate, and selva systems, each under annual dominance of one air mass, usually produce landforms directly related to the climate; semiarid and periglacial CPS occur mostly as parts of seasonal regimes (tropical wet-dry, Mediterranean, continental) in which two or more air masses interact, and their process assemblages are complex. Quantitative estimates of present climate-process relations are important in interpreting paleoclimates and relict landscapes. — VMJ

00055 **Wilson, Stanley D.; Marano, David.** Performance of Muddy Run Embankment — Closure [to discussion of paper 6026, 1968]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM 1, p. 300-301, illus., 1970.

Questions raised by Vasilescu, in his discussion of paper 6026 (ibid., v. 94, no. SM 4, p. 859-881, 1968], are answered. The reservoir was raised to +357 by March 17, 1967, and then raised in stages of 20 feet, attaining full pool elevation +520 on May 8, 1967. Two figures are revised to show dam behavior and upstream and downstream crest movements. No attempt was made to determine whether or not shear strength of weathered schist would be reduced by saturation; and no problems have arisen as a result of pore pressures in the foundation during drawdown. — ESL

00042 **Wing, R. S.; Dellwig, L. F.** Radar expression of Virginia Dale Precambrian ring-dike complex, Wyoming/Colorado: Geol. Soc. America Bull., v. 81, no. 1, p. 293-298, illus., 1970.

The Virginia Dale Precambrian ring-dike complex, at the extreme south end of the Laramie Range, was first recognized by W. A. Braddock in 1962 from high altitude air photos. This roughly circular feature is well expressed on 1957 early side-looking airborne radar (SLAR) imagery, from which in 1965 it was independently noted as a striking geomorphic (domal) anomaly. This particular imagery example illustrates the notable potential of radar imagery in general for delineation of larger scale elements, especially lineament patterns. The Virginia Dale complex is believed by the current authors to be of particular significance, not only for its relevance to Precambrian history, but also for possible influence on Phanerozoic events here, and in particular for its possible bearing on location of the Ferris-Aultman and other associated Paleozoic diatremes. — Authors' abstract

06525 **Winland, H. Dale.** Stability of calcium carbonate polymorphs in warm, shallow seawater: Jour. Sed. Petrology, v. 39, no. 4, p. 1579-1587, illus., tables, 1969.

High Mg calcite is recrystallized to aragonite in Recent marine carbonate sediments. Experimental results from distilled water should not be projected unmodified into the marine environment, as ions other than Ca can substitute for Ca in the structure of aragonite and calcite. The ratio of such foreign ions to Ca is defined by a thermodynamic equilibrium constant, the distribution coefficient, specific for each ion and structure at a given temperature and pressure. Equilibrium between $CaCO_3$ and seawater can be reached only if the distribution of major and minor ions between the separate phase is in agreement with this coefficient. Partition and stability information shows that marine carbonate sediments cannot undergo diagenesis to normal limestones, consisting of calcite containing 1 to 3 mol percent $MgCO_3$, in marine water. — *from* Author's abstract

Winter, J. K. *See* Langenheim, R. L., Jr. 07025

06677 **Wise, W. S.** Heulandite with excess water — A correction [to 1967 paper]: Mineralog. Mag., v. 37, no. 288, p. 522, table, 1969.

A water-rich heulandite previously reported in 1967 (ibid., v. 36, no. 277, p. 64-69), is in reality a stilbite from Skamania County, Washington. The mineral data are given in a table. — HRC

Wolleben, J. A. *See* Weidie, A. E. 06545

00075 **Wollenberg, Harold A.; Smith, Alan R.** Radiogenic heat production in prebatholithic rocks of the central Sierra Nevada: Jour. Geophys. Research, v. 75, no. 2, p. 431-438, illus., table, 1970

The radiogenic heat production in pregranitic rocks which are likely source material for the Sierra Nevada batholith is described. Similarities between them and the granitic rocks are found in radioelement content, and there are comparable regional variations in radioactivity. The question remains whether old rocks that produce 3μcal per g per yr, piled up to an appropriate thickness, can contribute enough heat to melt and granitize lower crustal material; it appears so. It seems reasonable to assume that a regional variation in radioactivity in the pregranitics would be present today in the batholith, upon which the profound effects of erosion are superimposed. — DBV

06991 **Woncik, John.** Recluse field, Campbell County, Wyoming: Mtn. Geologist, v. 6, no. 4, p. 221-226, illus., 1969.

The most significant exploration effort in the Rocky Mountain province during 1967-1968 was in the Muddy Cretaceous in the Powder River basin of Wyoming and Montana. Recluse field is one of several stratigraphic discoveries resulting from this effort. The producing Muddy Sandstone body is interpreted to be a barrier island deposited along the shoreline of the Muddy sea. The sandstone body is one-half to three miles wide and up to 47 feet thick. Local areas of thin sandstone crossing the barrier island are interpreted to be tidal channels. — Author's abstract

07027 **Woodward, Lee A.** Comparative tectonics and petroleum exploration in the western United States: Earth Sci. Bull., v. 2, no. 3, p. 5-13, illus., 1969.

Comparison of major tectonic elements in western United States shows some to be petroliferous. The Cordilleran eugeosyncline, characterized by intense folding, thrusting, regional metamorphism, and emplacement of ultrabasic to granitic bodies, is barren of petroleum. The miogeosyncline typically has flat thrusts with miles of displacement, strong folding, and regional metamorphism near the section base. Intrusions are common but small. It is not favorable for petroleum because of disharmonics above and below thrusts. The Rocky Mtn. shelf, characterized by vertical tectonics with secondary horizontal adjustments, has generally been favorable for exploration. Subtle stratigraphic facies changes related to structures offer attractive objectives. Younger basins, developed on the deformed eugeosyncline, are commonly petroliferous. Other basins on the former miogeosyncline are less attractive. — *from* Author's abstract

06574 **Woollard, G. P.** Geophysical analyses and gravity prediction studies (ACIC Contract F23601-68-C-0186, Final Rept.) — Pt. 1, A regional analysis of crustal structure in North America: Hawaii Inst. Geophysics [Rept.] HIG-69-12, 55 p., paged separately, illus., tables, 1969.

Present gravity prediction procedures are analyzed in the light of geophysical data concerning the crust and upper mantle. The Bouguer anomaly and isostatic correction are discussed for an east-west gravity traverse across the Rocky Mts. The maximum prediction error is associated with the Front Range, all predicted values across this area having a positive bias. Crustal thickness, density of lower crust and upper mantle, and geologic effects all contribute. It is not clear whether the Rocky Mts. are a horst, but they have risen 2,000 meters since the Miocene; the mountains are represented as a typical Miocene-type orogenic feature similar to the Alps. Crustal models associated with geologic provinces in the United States, and those for the continental United States are described. – ESL

07021 **Woollard, G. P.** Evaluation of the isostatic mechanism and role of mineralogic transformations from seismic and gravity data, *in* Geophysical analyses and gravity prediction studies (ACIC Contract F23601-68-C-0186, Final Rept.): Hawaii Inst. Geophysics [Rept.] HIG-69-12, 33 p., illus., tables, 1969.

The paper is devoted to presentation of substantiating evidence for the following: the isostatic phenomenon involved in one direction, an increase in gravity, crustal subsidence, an increase in crustal thickness, and a rise in mantle velocity; and in the other direction a decrease in gravity, in crustal thickness, uplift, and decrease in mantle velocity. The geologic record and gravity field over adjacent uplifts and basins suggest that the two operated simultaneously in adjacent areas. Subjects covered are gravity relations, seismic determinations of crustal and upper mantle abnormality, dependence of crustal parameters on mantle velocity, and relations where there is sub-Moho layering. — ESL

07022 **Woollard, G. P.; Machesky, L.; Monges Caldera, J.** A regional gravity survey of northern Mexico and the relation of Bouguer anomalies to regional geology and elevation in Mexico — Pt. 1, Final Rept., Contract DACA 71-67 C-0010: Hawaii Inst. Geophysics [Rept.] HIG-69-13, 52 p., illus., tables, 1969.

Previous gravity work in the area is reviewed, and instruments used, field and data reduction procedures, and anomaly computations are described. Gravity values from the Mexican Airport base net are tabulated, and evidence for secular changes in gravity in Mexico is given. A Bouguer anomaly map is included, and the relation of gravity to the geology of northern Mexico, Central Plateau area, Trans-Mexico volcanic belt, Sonoran Desert, and Sierra Madre Occidental is given. Sections are included on general relations on a $1° \times 1°$ basis and relation of the Bouguer anomaly to elevation. An evaluation of gravity prediction in Mexico is appended. — ESL

06687 **Woollard, George P.** An evaluation of gravity prediction in Mexico, *in* A regional gravity survey of northern Mexico and the relation of Bouguer anomalies to regional

geology and elevation in Mexico, Pt. 1: Hawaii Inst. Geophysics [Rept.] HIG-69-13, 23 p., paged separately, illus., tables, 1969.

The problem of predicting gravity is complicated by the triangular form of the continental block, abrupt transition in elevation from coast to continental shelf, presence of extrusive volcanic material obscuring the tectonic pattern, and apparent major breaks in crustal structure. Predictions based on the observed relation of 1° × 1° and 3° × 3° elevations to 1° × 1° Bouguer anomalies, and respective differences from observed anomalies are tabulated and shown graphically. From lat 22° to 28°, departures are positive over the western sector and negative east of volcanics of the Sierra Madre Occidental. Below lat 22°, divergence in predicted values is pronounced, especially at continental boundaries. South of 19°, over 100 mgal difference in predictions is reached. A detailed treatment of difference in predicted and observed anomalies in terms of geology on each east-west traverse is given. — ESL

Worzel, J. L. *See* Ewing, M. 06748

Wuensch, B. J. *See* Guillermo, Tomas R. 06719

Wuensch, B. J. *See* Cho, Seung-Am. 06756

07007 **Yeager, Donald.** A pollen profile from Kennedy's Bog in Mendon Ponds Park, *in* Studies on the plants of the Genesee Country (western New York State): Rochester Acad. Sci. Proc., v. 12, no. 1, p. 24-45, illus., 1969.

This study represents a first attempt to describe postglacial vegetation from records in western New York. The profile in Kennedy's Bog is similar to profiles from other bogs in the State, showing an early period of *Picea-Pinus*, followed by a period of *Pinus* dominance, giving way to a hemlock-hardwood interval containing three phases. *Acer* is abundant throughout the profile and *Fagus* shows increases and decreases. The xerothermic period is marked by a rise in *Fagus*, *Quercus*, and *Corya*, with a decrease in *Tsuga*. The abundance of *Acer* might be explained by proximity of the refugia re-entrant lobe. The amount of nonarboreal pollen is relatively small, but a steady rise beginning at the 12-ft level reaches a maximum at the 10-ft level, the family Cyperaceae accounting for the bulk of NAP. — *from* Author's summary

06493 **Yelverton, Charles A.** The relationship between geological conditions, erosion capacity and erosion control, *in* Engineering geology and soils engineering symposium, 7th Ann., Moscow, Idaho, 1969, Proc.: Boise Idaho, Idaho Dept. Highways, p. 211-222, tables, 1969.

Experience in southern California with cut and fill slope construction on many diverse types of geologic formations during 1945-69 fully demonstrate the direct relationship between geologic environment, topographic relief, and potential erosion characteristics of various rock types. A classification of rock types and weathering and erosion characteristics, based on 20 years' experience in the area, is given. Relationships between rock and soil types and vegetative cover required are discussed in terms of future performance of the slopes involved and expected maintenance by individual homeowners. Development of ordinances and fire-resistant plant and ground cover for slopes, and the effect of these measures, are discussed. — DBV

00014 **Yochelson, Ellis L.** North American Paleontological Convention: Science, v. 167, no. 3917, p. 398-400, 1970.

More than 500 paleontologists attended the North American Paleontological Convention, held in Chicago, September 5-7, 1969. It was the first profession-wide meeting in at least four decades. Eighty papers were read. The subjects discussed are reported briefly. — DBV

07038 **Yochelson, Ellis L.** Publication, microfilm, microcard, microfiche, and the International Code of Zoological Nomenclature: Systematic Zoology, v. 18, no. 4, p. 476-480, 1969.

Chapter 3 of this Code (Stoll and others, 1964), on criteria of publication contains several anachronisms which should be discussed in light of current trends in information handling, reconsidering the impact on nomenclature. In definition, the older Code (Stiles, 1910) used one word "publication"; the newer code gives one page of explanations divided into three articles, two of them attempting to determine what does constitute publication and what does not. More important than quibbling about ink and paper are: some method that assures numerous identical copies; medium for permanent record (not high-sulfur-content paper), distribution, printing costs. This commentator's version of a new revision in the code is presented. — GDC

06487 **Yong, R. N.; Japp, R. D.** Stress-strain behavior of clays in dynamic compression, *in* Vibration effects of earthquakes on soils and foundations — ASTM, 71st Ann. Mtg., San Francisco, 1968, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 450, p. 233-262, illus., tables, 1969.

The formulation of a flow rule relying upon a base value at particular strains and strain-rates and additive strength performance is shown. At higher rates of straining, significant increases in clay-soil strength cannot be totally accounted for by linear extrapolation of rate effects and the contribution from coupled inertia terms, but by nonlinearity in strain rates at the higher end of the strain-rate spectrum coupled with the formation of a quasi-shock front. The rate of impulsive loading is higher than the ability of the specimen to deform plastically in the region adjacent to the loading front, hence a moving shock front is created and significant increases in strength are realized because of the change in properties at the front. Instability in yield surfaces can be realized, and the problem of critical time-dependent yield surface as a function of strain-rate becomes apparent. — *from* Authors' abstract

06444 **Yoon, Hyo Sub; Newnham, R. E.** Elastic properties of fluorapatite: Am. Mineralogist, v. 54, nos. 7-8, p. 1193-1197, tables, 1969.

The elastic constants of Durango fluorapatite have been determined using the ultrasonic pulse superposition method. Room-temperature adiabatic stiffnesses are c_{11} 1.434, c_{33} 1.805, c_{44} 0.415, c_{12} 0.445, c_{13} 0.575, c_{66} 0.495 megabars. Comparison is made with measurements on bones and teeth. — Authors' abstract

York, D. *See* Macintyre, R. M. 06952

Younan, N. A. *See* Barden, Laing. 06387

06405 **Young, Robert A.; Mutchler, Calvin K.** Soil movement on irregular slopes: Water Resources Research, v. 5, no. 5, p. 1084-1089, illus., tables, 1969.

Soil loss and runoff were measured from concave, uniform and convex slopes subjected to simulated rainfall. Fluorescent glass particles and microrelief measurements were used to determine soil movement patterns in the slopes. For slopes of equal average steepness, a concave shape greatly reduced total sediment loss in comparison with that from either a uniform or convex slope. Average slope steepness was not a good indicator of soil delivery past a given point except for a uniform slope. In general, soil losses from irregular slopes depend on steepness of a short section of that slope immediately above the point of measurement. Soil movement off the plots was primarily transport by raindrop splash to a rill system and then down slope by runoff in the rill system. A breakdown of the rill system occurred on the bottom of the concave slopes because of decreasing local steepness, resulting in sheet flow and sediment deposition. — Authors' abstract

Young, W. M. *See* Hargraves, R. B. 06942

Yzerdraat, Walter. *See* Erdtmann, Bernd-D. 06798

Zeizel, E. P. *See* Case, C. M. 06507

00003 **Zetler, Bernard D.** International symposium on Earth Tides: EOS, v. 51, no. 1, p. 9-10, 1970.

The Sixth International Symposium on Earth Tides, organized by the Permanent Commission on Earth Tides of the International Association of Geodesy, was held at the University of Strasbourg, France, September 15-20, 1969. Papers again dealt primarily with instrumentation and data analysis, but there was a greater degree of open-mindedness and willingness to discuss new procedures than at previous meetings. American participation was somewhat greater than at previous meetings, and a presentation of the continental tidal gravity profile across the United States created considerable stir, partly because it was the first systematic earth-tide network in the U.S. but even more because it made possible a study of the loading effect from both the Atlantic and Pacific Oceans. The six resolutions adopted at the meeting are appended. – DBV

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